SIR® SYSTEM-2

OPERATION MANUAL

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How to Use This Manual

This manual is designed for both experienced and novice users of Subsurface Interface Radar (SIR) System-2. We recommend that all users read the entire manual.

This manual contains an index and glossary of terms for quick reference. On-screen help has also been provided for you. To access this help section while operating the SIR-2, press the H*elp* key (?) and an on-screen help menu will appear.

The following captions will help the SIR-2 user focus on key points in this manual:

NOTE:

This section will highlight important messages that point out the SIR-2's key features to help the user.

CAUTION:

This section will highlight important messages to help the user avoid processing pitfalls or fatal errors that could crash the system or result in the loss of data.

About this Manual

Certain conventions are used in this manual where they refer to commands, functions and menus.

- MENU NAMES will appear in small capital letters.
- Tools and Functions will appear with initial capital letters.
- **Commands** you choose from the menus will appear in bold with the first letter capitalized.
- *Keys* on the keyboard will appear in italics.
- *Buttons* and *Icons* will also appear in italics.

NOTE:

This manual assumes that you will have a SIR-2 available and in operation when reading this manual.

Help can be obtained on any command by pressing the *Help* (?) key for context-sensitive help and then the *Enter* (↵) key for general help.

CHAPTER 1: INTRODUCTION

1.1 Unpacking Your System

Thank you for purchasing a GSSI SIR® System-2 (from now on referred to as SIR-2). A packing list is included with your shipment that identifies all of the items that are in your order. You should check your shipment against the packing list upon receipt of your shipment. If you find an item is missing or damaged during shipment, please call or fax your sales representative immediately so that we can correct the problem.

Your SIR-2 contains the following items:

1 - Digital Control Unit (DC-2)
1 - Antenna control cable
1 - DC Power cable (SIR-2 power connector on one end and a cigarette lighter plug on the other end)
1 - Power Connector Adapter (Cigarette lighter socket on one end and a GSSI three pin power connector on the other end)
1 - Upgrade adapter cable (keyboard and serial port cable)
1 - Serial null modem cable (9 pin to 9 pin cable)
1 - DC-2 padded carrying case, with sunshade
1 - SIR System-2 Operation Manual
1 - PC operating system software, MS-DOS

If you purchased some the following available optional items they will also be included:

Portable Battery Kit
DPU-5400 Thermal Printer

1.2 General Description

The SIR-2 is a lightweight, portable, single channel general purpose ground penetrating radar system. The various components of the DC-2 control unit are briefly described below.

The major external components of the control unit are the keypad, video screen, connector panel and indicator lights. The keypad consists of 10 keys which are used to control operation of the unit. The VGA liquid crystal display (LCD) video screen provides real-time or playback viewing of the data. There are five connectors located on the SIR-2. The connector labeled BATTERY connects to the power supply. The connector labeled ANTENNA connects to a GSSI antenna. The PARALLEL connector is used to connect a thermal printer or to transfer data to a computer. The MULTIFUNCTION connector will connect to the upgrade adapter cable or optional Model 25 multifunction box. The XMIT connector provides a fiber optic transmit trigger output for the Model 3200 Multiple Low Frequency (MLF) antenna. The red and green indicator lights, located above the power switch, indicate power supply to the unit. The amber light on the upper right to indicate hard disk activity.

Powered by a 12 VDC battery, there are two ways that the system can be used, either as a stationary unit or as portable unit to be carried by the investigator. The system is setup and run by the operator via the keypad on the front of the unit. Data can be stored on an internal hard disk drive and optionally printed in real-time on a thermal printer. Data is transferred from the system to a computer via a parallel port for post-processing and analysis.

The SIR-2 can be used with all GSSI antennas from 2000 MHz to 16 MHz. Depending upon subsurface conditions or a building's structural design, this will provide depths of penetration ranging from a few centimeters (inches) to tens of meters (feet).

1.3 Power Requirements

The SIR-2 control unit requires a 12 VDC power input at 3 amperes (at the input connector, not at the power source. Note that some loss can occur in the power supply cables). If you purchased a GSSI battery pack to power your SIR-2, one of the batteries supplied with the pack will be able to power the system for the following times:

4.5 +/- 0.5 hours at 40°C

4 +/- 0.5 hours at 20°C

3 +/-0.5 hours at 0°C

The above times assume a fully charged battery and GSSI-supplied battery cables. The system can also be powered with an automobile battery or a deep-cycle marine battery. If you power the system from an automobile battery, you should keep the engine running while operating the system, or you will risk depleting the car's battery to the point where you will be unable to start the engine.

⚠ CAUTION:

If you power the system from a vehicle battery, you should keep the vehicle running while operating the system.

If during system operation the input voltage becomes low, the green light above the power button will begin flashing. You should shut down the system as soon as possible and replace or recharge your power source.

POWER INDICATOR LIGHTS

The red and green power indicator lights are above the power button.

GREEN LIGHT - When an adequate power source has been connected to the system the green indicator light will illuminate, even before the system is turned on. **If the power source is inadequate, the green light will be flashing or not illuminate**. A flashing green light indicates that the input voltage to the system is less than 10.2v or greater than 18.0v. Check your power source to obtain the appropriate voltage. **If the input power becomes too low while operating the system, the green light will begin flashing.** You

should shut down the system as soon as possible and replace or recharge your power source.

RED LIGHT - When the system is turned on the red light will illuminate.

The battery charger supplied by GSSI with the SIR-2 (if ordered with your system) has two lights on the front panel. One is a power indicator light which illuminates when input power is applied to the unit. The other is a “fast-charge” light which will illuminate only during the initial or “fast-charge” phase of battery recharge. When this light goes out, it does not mean that the battery is fully charged, only that the initial or high-current draw phase of the recharge has finished. To ensure that the battery is fully charged, leave it connected to the charger for at least 8 hours.

Note: When using a GSSI high or very high powered transmitter (Models 775, 776, 777 or 778) with the SIR-2 you should use the GSSI Model 570 fiber-optic trigger between the transmitting and receiving antennas. The SIR-2 does not have sufficient power to drive the high power pulse amplifiers at a satisfactory repetition rate when a coaxial cable is connecting the transmitting and receiving antennas.

1.4 Operating Environment

The SIR-2 is designed to operate from 0^{o}C (32^{o}F) to 40^{o}C (104^{o}F). The unit is environmentally sealed and can be used in dusty or humid environments. Though the system is designed to withstand occasional exposure to water it should not be deliberately subjected to rain or immersed in water. A heat-sink plate is located in the bottom of the system and used to regulate the internal temperature of the unit, and air must be free to circulate around it. Therefore, the system should not be operated while inside the carrying and storage pack .

The video screen is a color active-matrix liquid crystal display (LCD) covered by a polarizing screen to improve viewing in bright light. A velcro attachable sun shade is also included with your system. However, even with the polarizing screen, the data can be difficult to view in bright sunlight. Turning the system so that the screen does not directly face the sun and using the sun shade will make the data easier to view. Sometimes it will be necessary to completely shade the unit in order to see the image on the screen.

NOTE:

The SIR-2 is designed to operate from 0^{o}C (32^{o}F) to 40^{o}C (104^{o}F). The SIR-2 control unit can operate in dusty, humid or foggy environments but it should not be deliberately subjected to direct rain or immersed in water.

Turning the system so that the screen does not directly face the sun and using the sun shade will make the data easier to view in bright sunlight.

The screen on the SIR-2 is plastic and susceptible to scratching. Reasonable care should be exercised in protecting the screen from sharp objects which may scratch it. Do not use

harsh chemicals to clean the screen. We recommend using a soft cloth dampened with clean water.

CHAPTER 2: BASICS OF SYSTEM OPERATION

2.1 Hardware Connections

Only two simple connections need to be made before you can start the system.

1. The male end of the antenna control cable should be connected to the antenna connector on the SIR-2 control unit. The 11-pin connector at the other end of the control cable should be connected to a GSSI antenna. Because the control cable connector on the SIR-2 is different, older GSSI antenna cables will not connect directly to the control unit. You will need to connect the antenna cable provided with your SIR-2 system to the control unit and connect older GSSI antenna cables to that cable by connecting a cable adapter between the two cables.

NOTE:

If you are going to playback data, it is preferable not to connect the antenna to the SIR-2 before powering ON the system.

2. The male end of the DC power cable should be connected to the battery connector on the control unit.

The following connections are for optional items:

a) If a thermal printer is to be used, the male end of the thermal printer cable should be connected to the parallel connector of the control unit and the other end should be connected to the printer. See Chapter 6 for details on using thermal printers.

CAUTION:

If you connect a printer to the SIR-2, the printer must be powered ON before the SIR-2.

b) If a survey wheel is to be used, connect the survey wheel to the antenna.

After all other connections have been made connect the power cable to the power source. If the battery voltage is adequate, the green light above the power button will become illuminated and remain illuminated. If the battery voltage is low, the green light will flash. If the green light is flashing, you should correct the low voltage problem before starting the system.

CAUTION:

If the battery voltage is low, the green light above the power button will flash. If the green light is flashing, you should correct the low voltage problem before starting the system.

2.2 System Startup

This section will describe the initial sequence during startup.

Pressing the *Power* button in the top left corner of the SIR-2 will turn ON the system. After power up both the green and red lights above the power button should be illuminated. If the green light is dark and the system will not power ON, you have inadequate input power. Check your power source.

NOTE:

If the green light is dark and the system will not power ON, you have inadequate input power. Check your power source and connections between your power cables.

The SIR-2 will show a series of DOS messages during the start-up sequence, then:

- The SIR-2 Radar Control Unit opening screen will appear showing the version of the operating system software.
- At the bottom of the screen you are given the following choices:

  press the *Run* key for Automatic operation - see Chapter 9

  press the *Enter* key for Standard operation

At this point, we will press the *Enter* key and initiate Standard operation. When the *Enter* key is pressed, the following message appears at the bottom of the screen:

Press: the *Left Arrow* key for Previous Setup or the *Right Arrow* key for Stored Setups

- If you choose **Stored Setups**, a list of system operating parameters setup files will be displayed on the screen. Many of these files are GSSI custom files for easy setup of the various GSSI antennas. (For a description of the contents and selection of the various parameter setup files see Appendix A). Use the *Arrow* keys to highlight the name of the setup file you wish to recall. Press the *Enter* key to recall the setup file and set the system. A second screen will appear asking you to confirm the recall. After the system is set you will be in the COLLECT SETUP MENU block. If there is no antenna connected to the system, and you try to recall a setup file, the message "No Data Available" will appear on the screen.
- If you choose **Previous Setup**, the system will recall the same operating parameter settings as the last time it was used. It will then enter the COLLECT SETUP MENU block.

- If an antenna is not connected to the system and you choose **Previous Setup,** the system will enter the PLAYBACK SETUP MENU block. See Chapter 5 for a description of the PLAYBACK SETUP MENU block. If you accidentally choose **Stored Setups**, press *Enter* ↵ and then **Cancel**. The system will then enter the PLAYBACK SETUP MENU BLOCK.

Once in the COLLECT SETUP MENU block, data coming from the antenna will show on the top left ¾ of the screen, and oscilloscope display of the data in the top right ¼ of the screen and the bottom portion of the screen will show the COLLECT SETUP MENU block. Note that the data being acquired at this time is only displayed to the screen and it is **not** saved on disk.

Review the remainder of Chapter 2 for a general description of how to use the system, then go to Chapter 3 for system data collection parameters setup.

2.2.1 System Startup for the SIR-2P

When the SIR-2P is turned on and goes through its boot routine, you will see a small window near the top of the screen that says: 1 or F1 Run SIR-2; 2 or F2, WIN95/RADAN. If you take no action for 30 seconds, the system will default to SIR-2 mode. When it boots into the SIR-2 mode, you will be given a choice of two modes of operation at the top screen: press **Run** for Automatic operation or press **Enter** for Standard operation.

Once in SIR-2 mode, if you want to switch to the Windows95 (WIN 95) mode you must turn the system OFF and reboot, then select option 2, **WIN95/RADAN**.

In WIN95 mode the system acts like a normal computer with the Windows 95 operating system. From here, you can launch RADAN or any other software that has been pre-loaded. To turn the system OFF in WIN95 mode, hold the power switch down for at least 8 seconds.

If you connect the SIR-2P to a network through the ethernet connection, the password to use is “sir2p”.

2.3 Using The HELP Key To Get Help

Highlight any menu command and then press the ?(*Help*) ? key to get help on that command. Press the *Help* ? key and then the *Enter* ↵ key to get general help on the system. Help for some commands is longer than one screen, and in these cases use the *Down* ↓ arrow key to obtain the additional screens of help.

NOTE:

General system help can be obtained by pressing the *Help* ? key and then the *Enter* ↵ key. If at any time you are unsure of the current system parameter settings press the *Collect/Playback* % key until the system parameters screen appears.

2.4 The Operating Keys

The SIR-2 is operated via a scrolling menu system which is controlled by nine keys. There is also a power ON/OFF key. This section describes the function of the operating keys and the three indicator lights on the top of the system.

**POWER KEY - ** This key is used to turn the system ON and OFF. If power is accidentally disconnected, an internal battery supplies adequate power to ensure that the current disk file is properly closed.

RED AND GREEN POWER INDICATOR LIGHTS - When the system is connected to an adequate power source, (whether the system is turned ON or OFF), the green light will illuminate steady. If the power source voltage is low, the green light will flash. If the green light is flashing, you should not turn the system ON. When the system is powered ON, the red indicator light should illuminate. The green light will begin flashing during operation if the voltage drops below acceptable levels (See Section 1.3 for more details on the power lights).

**? (HELP) KEY - ** Highlight any menu command and then press the ?(*Help*) key to get help on that command. Press the *Help* key and then the *Enter* key to get general help on the system.

PRINT KEY - ** This key is used in conjunction with the **Select Block command to produce snapshot prints of the data.

**COLLECT/PLAYBACK KEY - ** This key is used to toggle the system between Collect Setup Mode, Playback Setup Mode and the Setup Parameters screen.

**ENTER KEY - ** This key is used to toggle through options of menu parameters surrounded by a box, and to accept parameter value changes.

THE ARROW DIAMOND - This arrow diamond is used to move around the menu columns. It is also used to change the values of parameters where appropriate. When in Collect Data Mode, and the system is scanning, pressing the *Up* arrow will generate location markers in the data.

**RUN/STANDBY KEY - ** When in COLLECT SETUP MENU block, this key starts the system collecting data. When the system is collecting data, pressing this key will pause data collection. When the system is collecting data, pressing this key and holding it for 2 seconds will stop collecting data and close the file. When in Playback Mode, pressing this key will start playback of the selected file(s). Press the key a second time to pause data playback. When paused, press again to resume playback.

**THE AMBER HDD INDICATOR LIGHT - ** When the hard disk is active reading or writing data, this light is illuminated.

2.5 Navigating Through The User Menus

2.5.1 The Major Menu Blocks

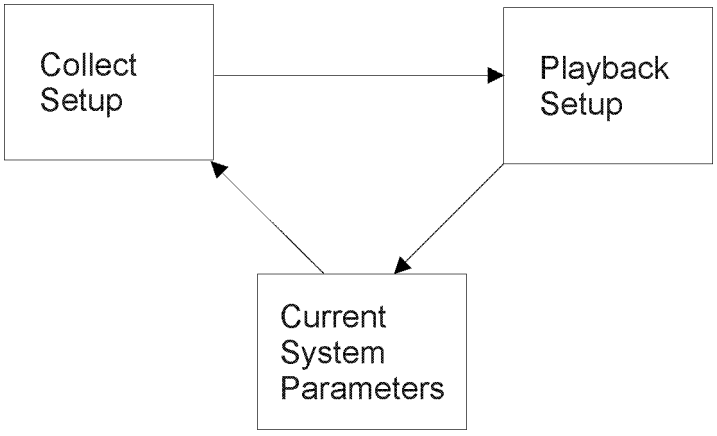
The SIR-2 has 4 major MENU blocks:

- COLLECT SETUP
- PLAYBACK SETUP
- PLAYBACK DATA
- COLLECT DATA

The system will identify which block is active by a message appearing in the lower portion of the menu block.

SETUP MENU BLOCKS

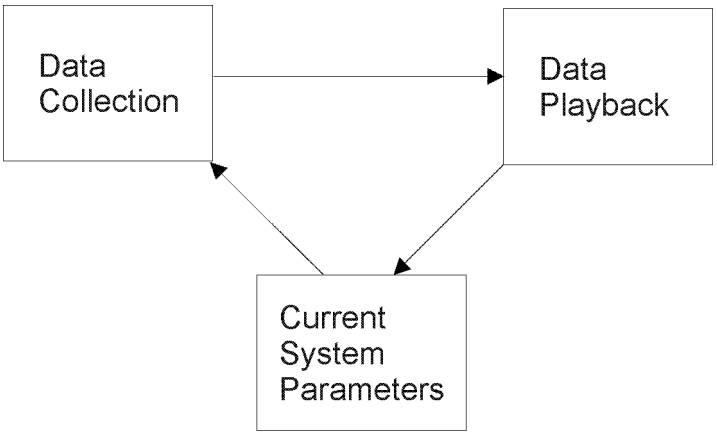
When the system is first turned ON, it is in Setup Mode. When in the SETUP MAJOR MENU block, pressing the *Collect/Playback* button cycles through the major menu blocks; COLLECT SETUP and PLAYBACK SETUP, and the Current System Parameters screen (Figure 2-1).



Cycling through the major menu blocks when in Setup Mode
by repeatedly pressing the *Collect/Playback* key
FIGURE 2-1

COLLECT DATA AND PLAYBACK DATA MENU BLOCKS

To put the system in Data Mode, press the *Run/Standby* key. This will start the system collecting data (**Note: By default the data will be stored in RAM. It will only be stored on the hard disk if you turn disk output ON. See Section 3.2.3**). In the Data Mode, pressing the *Collect/Playback* button cycles through the major menu blocks; COLLECT DATA and PLAYBACK DATA, the current system parameters screen and then the COLLECT SETUP MENU BLOCK (Figure 2-2).



Cycling through the major menu blocks when in Run Mode,
by repeatedly pressing the *Collect/Playback* key
FIGURE 2-2

To return the system to SETUP mode, select GO TO SETUP from the first menu column.

NOTE:

When the SIR-2 is first turned ON it is in Setup Mode.

To put the system in the DATA MENU block, press the *Run/Standby* key. When in a DATA MENU block, to return the system to setup mode, select **Go To Setup Mode** from the first menu column**.**

CAUTION:

Data stored to RAM will be lost when the system is powered OFF or when the next data file is collected. To permanently save your data, you must set the **Disk Output Parameter** to ON.

2.5.2 Using The Menus

The menu palette is prioritized from left to right. The left-most column of commands is referred to as the first column, the next column to the right is referred to as the second column, etc. The currently highlighted item is the active item. The user can navigate between items using the *Arrow* keys. To select and activate a command, move the highlight bar to that command and press the *Enter* key.

- The left-most column consists of super commands that, when selected, bring up a list of commands in the second column.

- The middle columns consist of two types of system parameters: those whose values appear in a box and can be changed via the toggle switch method and those whose values can be changed by a parameter change box. When a parameter from these columns is highlighted and then the *Enter* ↵ key is pressed, one of two things will happen: If it is a toggle switch parameter, the value of the parameter will change each time *Enter* ↵ is pressed; if the parameter requires a wide range of values a parameter change box will appear as a third column. The *Up* ↑ and *Down* ↓ keys will be used to increment/ decrement value of the parameter by the step size; the *Left* ← and *Right* → keys will allow you to select step size. The *Enter* ↵ key will set the selected value of that parameter.

NOTE:

Throughout the remainder of the manual when the expression "select a command" is used, it means move the highlight bar to illuminate that command and then press the *Enter* ↵ key. This will select (i.e., activate) that command.

Let's look at some examples of using the menus.

1) PLAYBACK SETUP menu block, if you highlight the **Files** command from the leftmost column a list of commands will appear in a second column.

2 Now, using the *Arrow* ← ↑ ↓ → keys move to the second column and highlight the **Compress** command. A third column containing two compression commands appear, **Method** and **Do Compress**.

3) Finally, if you move the highlight bar to the **Method** command and press the *Enter* ↵ key three times slowly. Notice that this changes the type of compression method.

4) In the COLLECT SETUP MENU block move the highlight bar to the **Setup** command and then to the **Range** command. Notice that a parameter change box appears to the right. Move the highlight bar to the **Parameter Change** box to change the value of the range. Then press the *Enter* ↵ key to register the change.

2.6 Recalling Preset Files To Automatically Set The System For Data Acquisition

When the system is first turned ON or after switching antennas, the system can be easily set for data acquisition by selecting the operating parameters setup file that is most appropriate for the selected antenna and job. This is done using the **Recall Setup** command accessed from the **Setup** command in the COLLECT SETUP MENU block or the PLAYBACK SETUP MENU block. This command is next to the bottom of the second column of commands.

RECALL SETUP

This command allows you to setup the system by recalling a file of previous system settings. See Appendix A for a detailed description of all the GSSI preset parameter setup files.

When this command is highlighted and the *Enter* ↵ key pressed, a list of 29 factory preset and 56 user-definable setup files will be displayed on the screen. Use the *Arrow* ←↑↓→ keys to highlight the name of the setup file you wish to recall. Press the *Enter* ↵ key twice to recall and confirm the setup file you want to configure the system. (Go to Section 3.1 for a list of parameters to check after recalling a system setup).

SHOW SETUP

This command will display the current system settings.

CHAPTER 3: SYSTEM SETUP FOR DATA COLLECTION

3.1 Simple (Quick) System Setup For Data Collection

After loading the appropriate system operating parameters setup file (see Appendix A for a description of the setup files), the following few parameters should be checked to ensure that they are optimal for your specific site.

The system should be in the COLLECT SETUP menu block.

1) Check the **Range** (i.e., depth) of viewing.

This is done by moving the highlight bar up to the Range parameter. The appropriate range value is calculated by the following formula:

RANGE VALUE = Maximum Depth of Interest * T * 1.5

Where T is the two-way travel time of the subsurface materials at your site. For a table of two-way travel time values see the discussion of range in Section 3.2.2. After the range value is changed, the system will automatically find the position of the ground surface reflection and place it at the top of the data screen. It will also readjust the gains (the message "servo in progress, please wait" will appear, and the speaker will emit a “clicking” sound while this is occurring).

2) Check the position of the ground surface reflection.

Normally, the surface reflection will appear in the color bar at the top of the O-scope data display. Occasionally the system will misidentify a different reflection for the ground surface reflection. (It is especially prone to do this with the horn antennas, 1000 MHz antenna, 3200 MLF antenna, bistatic 100 MHz and the bistatic 300 MHz antenna.) In this case, the real surface reflection will occur before the top of the signal (as displayed in the O-scope display). Move the highlight bar down until the **Position** command is highlighted and press the *Enter* ↵ key to change position to Manual Mode. Move to the parameter change box and use the *Down* ↓ arrow to decrease the position value by 5ns if the range is less than 20ns, by 10ns if the range is between 20ns and 100ns and by 50ns if the range is greater than 100ns. (Note that when changing the position value the system will often round off values.) Before you change the position value you should note the original value. Press the *Enter* ↵ key to implement the position change.

After changing the position value, you will observe one of two things:

1) If the oscilloscope display shows the data is flat (no signal) at the top and a strong surface reflection appears further down, the system correctly found the surface reflection. Move the highlight bar to the **Parameter Change** box again and set the position value back to the original number before you changed it.

2) If the data is not flat at the top of the record the wrong surface position was found. You should keep manually decreasing the surface position by increments of 5 or

10ns until the data is flat at the top. At that point you will have correctly found the surface position.

3) Check the **Gains** to ensure proper signal amplification.

If the gains are set correctly, the largest signals (i.e., reflections) in the oscilloscope display should be 75% the width of the display and the data screen should show mostly (60% to 80%) red, orange and yellow reflections (using the default Color Table 2 And Color Transform 1). If you use a different color table or transform the above colors will not apply.

If the gains values are too low, a significant (> 25%) portion of the data reflections will show as black and grey (low signal). In this case increase the value of the gain point(s) associated with the low signal zone, until the signals in that zone are red and orange. The time markers to the left of the oscilloscope display correspond to the gain points. Thus, the time label at the top of the screen is gain point 1 and the next time label is gain point 2, the next time label is gain point 3, and so on. The number of time labels is the same as the number of gain points. Therefore, if the top of the display has low amplitude you should increase the value of gain points 1 and 2. The gains are changed by changing the **Gain** parameter to manual by pressing the *Enter* ↵ key and then changing the values of individual points. (See Section 3.2.2 for details on setting the gains.)

4) Check the **Run Mode** (i.e., data collection method).

If you will be collecting data continuously along survey lines, then **Run Mode** should be set to **Cont**.

If you will be using a GSSI survey wheel to control data collection, **Run Mode** should be set to **SW**. You must calibrate the survey wheel before using it! (See Section 3.2.1 for details.)

If you will be collecting data at discrete data points along the survey lines, set the **Run Mode** to **Point**.

5) Check your output devices.

Go to the OUTPUT MENU item and check to ensure that **Disk** is ON. If you want to use a thermal printer to make real-time printouts of your data, set **Print** to ON. Note - there will be a long delay here (about a minute) if the printer is not connected and powered ON, the speaker will sound and the screen will display a window that says “Plotter error - Hit any key to continue.” If you press the key more than once, the delay time will stack up.

6) Check the Display Mode.

By default the display is Color Linescan. If you want to change to Linescan grayscale, Wiggle trace or Oscilloscope display change the **Display Parameter**.

7) Press the *Run/Standby* ⏯ key to begin collecting data.

This will start the data collection and place the system in the COLLECT DATA MENU block. See Chapter 4 for further details on data collection.

3.2 Complete Description Of Collect Setup Menu Block

SETUP

When this command is highlighted, a set of system data collection parameters that can be set appears in the second column. The commands that will appear in the second column are: Setup Mode, Run Mode, Range, Gain, Position, Filters, Scan, Save Setup, Recall Setup, and Show Setup.

SETUP MODE

This parameter determines how the system parameters will be set. There are two setup modes: Automatic and Manual. The mode is changed by pressing the *Enter* ↵ key.

When the Setup Mode is set to **Automatic,** the system will automatically find the ground surface reflection and place it at the top of the screen, set the filters, gains, scan speed and data resolution. It will not automatically set the range. The range used will be that which is set prior to putting the system in Automatic Mode. After automatic setup the user can manually change any system settings.

When the Setup Mode is set to **Manual**, the user can manually set all system parameters to the desired settings.

> ⚠ **CAUTION:**
>
> When the Setup Mode is set to **Auto**, the Gain Position, Filters and Scan Parameters will be hidden.

3.2.1 Setting The Data Acquisition Method

RUN MODE

This parameter informs the system how the field survey will be conducted. There are three methods of data acquisition: Cont (continuous), Point and SW (survey wheel). The system Run Mode is changed using the *Enter* ↵ key.

CONTINUOUS DATA COLLECTION METHOD

When the Run Mode is set to **Cont** (Continuous), the system is continuously transmitting signals into the ground and recording data. The advantages of this mode are that a continuous profile of the subsurface is generated and it is the most rapid data collection method.

SURVEY WHEEL CONTROLLED DATA COLLECTION METHOD

When the Run Mode is set to **SW** (Survey Wheel), a third column of survey wheel data collection parameters appears. In this mode data collection is controlled by a survey wheel attached to the antenna. All lines will then have the same horizontal scaling. This mode is preferable for surveys which require precise line locations.

UNITS

This parameter is used to set the survey units. Use the *Enter* ↵ key to switch between meters and feet.

SCANS/UNIT

The scans per unit parameter sets the horizontal sampling along the ground that is controlled by the survey wheel. The larger the value for the scans/unit, the more often the radar will scan the ground. For concrete surveys with the 1000 MHz or 900 MHz antennas, a setting of 40 scans/unit is typical. For near surface (1-3 meters) utility surveys with the 500 MHz or 300 MHz antennas, a setting of 20 scans per meter is normal. Often for large scale surveys (i.e., bedrock mapping) a coarser horizontal sampling is desired and settings of 1 to 10 scans per meter are typical. Sometimes surveys are done pulling antennas with a vehicle at a higher rate of speed (ex. 2-5 meters (6-15 ft) per second). In these cases, settings of 0.1 to 1 scans per unit are typical.

UNITS/MARK

This value determines how often distance marks are placed on the data display. Typical values for concrete and near surface surveys where high horizontal resolution is critical are .1 (marks every 10cm) to .5 (marks every 0.5 meters). Typical values for utility surveys and deep stratigraphic surveys are 0.5 (marks every 0.5 meters) to 5.0 (marks every 5 meters).

DIR

This is the direction of the survey wheel rotation. If it rotates clockwise, when viewed from the same side as the encoder, choose **Forward**; counterclockwise, choose **Reverse**. If you are unsure, try setting this first to forward and if you do not get a system response when calibrating the survey wheel, set it to reverse. When the survey wheel is calibrated, the direction is automatically sensed and set to the appropriate direction (i.e., same direction as calibration run). After calibration, the wheel direction will be automatically sensed by the system, increasing survey efficiency and making tasks such as pipe location easier.

NOTE:

The Survey Wheel must be calibrated at your survey site before use.

SURVEY WHEEL CALIBRATION

Survey wheel calibration is done by selecting the command **SW Calibr.** A list of survey wheel calibration commands will then appear in the right column.

AUTO CALIBR

You must calibrate the survey wheel before each survey. You should perform the following steps to autocalibrate the survey wheel for your site:

1) Choose a survey wheel calibration line that is at least 50% as long as your maximum survey line. Enter the distance of the survey calibration line in the distance parameter.

2) Select the survey units either meters or feet.
3) Set the antenna at the beginning of your survey calibration line with the middle of the antenna on the beginning of the line.
4) Activate the **Autocalibrate** function by pressing the *Enter* ↵ key and then the *Run/Standby* key.
5) Move the antenna over the survey calibration line very slowly (less than 0.5meters (1.5ft) per second), until the middle of the antenna reaches the end of the survey calibration line.
6) When finished calibrating, press the *Run/Standby* key to end the calibration.
7) Your survey wheel is now calibrated and ready for use.

UNITS

Use the *Enter* ↵ key to select the survey units **Meters** or **Feet**.

DISTANCE

Enter the distance of the survey wheel calibration line. The distance should be at least 50% of the longest line in the survey to be performed.

TICK/UNIT

If you know the number of electronic ticks per meter or feet that your survey wheel will send to the SIR-2 system, you can enter the number here. With this number it is not required to calibrate the survey wheel. We strongly recommend using the Autocalibrate function instead of entering a tick/unit value, because ground conditions change and when the system is Autocalibrated it will take this into account to some extent.

DISCRETE DATA POINT DATA COLLECTION METHOD

When the Run Mode is set to **Point,** the parameter Stat Stack appears in the third column. When in Point Mode, data is collected a predetermined number of scans per survey station (i.e., every time the *Run/Standby* key is pressed another number of scans are collected). This mode is useful in rough terrain where continuous data collection is impossible and in areas where the signal is very weak at deep depths and maximum signal enhancement is required. When using Point Mode, it is recommended that Wiggle Display Mode be used.

Be aware that the display shows a simulated stack while in Collect Setup. The system shows the actual stack when switched to Run Mode and you start acquiring data.

STAT STACK

In order to improve signal-to-noise in Point Mode, it is advantageous to stack (i.e., average) several input scans into one output scan at each station. The Stat Stack parameter allows you to set the number of scans that will be averaged. The value is typically set to 32, and the range is from 1 to 32768 in binary steps. Thus, when the value is set to 32 at each station, 32 scans will enter the system from the antenna and be summed into one scan. The resulting scan will be output to the video screen and stored on

disk. If the data is of poor quality during your test lines, try increasing the value of Stat Stack**.**

3.2.2 Setting The Data Acquisition Parameters

RANGE

The Range parameter is a time value in nanoseconds. When you set the range to a value, (for example: 10 nanoseconds) this tells the system how long to record received reflected signals after it sends out a radar pulse. Any portion of the radar pulse which can penetrate into the ground, reflect from an object or boundary and return to the antenna within 10 nanoseconds is recorded and displayed (this record is termed a scan). When the system is set to record for 10 nanoseconds, signals cannot penetrate very far into the earth and return within 10 nanoseconds. However, if the range is set to 100 nanoseconds, signals can penetrate much further into the ground and return to the antenna within 100 nanoseconds, and you have effectively increased your depth of viewing.

Note that for a given antenna frequency at a given site, there is always a maximum depth into the ground that the radar signal can penetrate. There is some maximum range value for any given situation beyond which you will get no signal. ***Ground penetrating radar signals will not travel through metal or salt water***.

The range value to set, for your particular job, is determined by the following formula:

$$RANGE = D \times T \times 1.5$$

where,

D - is the maximum depth of interest

T - is the two-way travel time of the subsurface materials. This is the time it takes for the radar wave to travel down and back through one meter (or foot) of a particular material. For your particular site, make the best determination of what the particular subsurface material is and refer to Table 1 below to obtain an estimate for the two-way travel time. This value can then be used in the formula above to determine the proper range setting.

WARNING: the two-way travel time values are only estimates. The exact two-way travel time at your site will likely vary somewhat from the estimated values.

Material	T (ns/meters)	T (ns/feet)
Air	6.5	2
Ice	13	4
Snow	8	2.5
Water	59	18
Asphalt	14	4.5
Dry concrete	15	4.5
Wet concrete	23	7
Dry sands	13	4
Wet sands	25.5	7.5
Saturated sands	33	10
Dry sand & gravel	15.5	4.5
Frozen sand & gravel	14.5	4.5
Dry loamy/clayey soils	10.5	3
Dry mineral/sandy soils	16	5
Organic soils	52.5	16
Wet sandy soils	32	9.5
Frozen soil/permafrost	16	5
Tills	22	6.5
Peats	51.5	15.5
Wet clay	34	10.5
Dry clay	13	4
Dry granite	14.5	4.5
Wet granite	16.5	5
Wet basalt	19	6
Volcanic ash	23.5	7
Potash ore	15.	4.5
Dry bauxite	33	10
Syenite porphyry	16	5
Travertine	18.5	5.5
Coal	14	4
Dry limestone	15.5	4.5
Wet limestone	18.5	5.5
Wet sandstone	16	5
Dry salt	16	5

Approximate two-way travel time values of various materials

TABLE 1

ESTIMATING THE DEPTH OF A TARGET

To estimate the depth of an object or layer on the radar record, with the system in Standby, enter the Cursor Mode (from the COLLECT DATA MENU BLOCK) and measure the two-way travel-time to the target. This is done by moving the horizontal cursor line until it aligns with the top of the object; the two-way travel-time is the Y value in nanoseconds (ns) at the bottom of the screen. Divide the two-way travel time by your estimated two-way travel time value from the Table 1 above and the result will be an *estimate* of the depth to the object or layer. Alternatively, if the VERT SCALE=DEPTH, the cursor will read the depth directly (provided the dielectric value is set properly).

GAIN

The signal from the antenna that enters the SIR-2 is very low amplitude and must be amplified by the system for viewing and interpretation. The amount of amplification necessary depends upon the subsurface conditions at the particular site and varies from site to site. The gain function (curve) is equal to the amount of amplification the SIR-2 applies and can be set to provide the best amplification for data presentation at the site you are working on.

The gain parameter can be set to Auto or Manual using the *Enter* ↵ key. When set to **Auto,** the system will automatically set a gain function based on the data input. When in Manual Mode, the user can manually change the gain function. When this is set to **Manual,** the gain point values appear in the third column and can be adjusted.

Since reflections from greater depths require more amplification, the amount of amplification increases with depth. Thus, the SIR-2 applies what is called a time-varying gain (TVG) curve. The number of points used to define the curve is controlled by the user and can vary from 1 to 8. The use of 3 to 5 gain points is typical.

When manually adjusting the gain curve, the gains are set correctly when the largest signals (reflections) in the oscilloscope display are 75% the width of the display and the data screen shows mostly (60% to 80%) red, orange and yellow reflections. The colors described above are based on Color Table 2. If you use a different color table the correct gain colors will be different, but the same principle applies.

If the gains values are set too low, a significant (> 25%) portion of the data reflections will show as black and gray (low signal). You should increase the value of the gain point(s) associated with the low signal zone, until the signals in that zone display red and orange. The time markers to the left of the oscilloscope display correspond to the gain points. The time label at the top of the screen is gain point 1 and the next time label is gain point 2, and the next time label is gain point 3, and so on. The number of time labels is the same as the number of gain points.

NOTE:

When manually adjusting the gain curve, if the gains are set correctly, the largest signals (reflections) in the oscilloscope display should be 75% the width of the display and the data screen should show mostly (60% to 80%) red, orange and yellow reflections. The colors described above are based on color table 2. If you use a different color table the correct gain colors will be different.

GAIN POINTS

The number of gain points can be set from 1 to 8, and is normally set between 3 and 5. You may want to use fewer gain points (2 or 3) for shallow scans (5-15ns) made with our high-frequency, high resolution antennas for detecting steel reinforcing bars or mesh in concrete. Conversely, you may want to use more gain points (6 or 8) to allow greater adjustment flexibility when doing deep investigations (200-1000+ns).

POSITION

This parameter controls the vertical position of the surface reflection in the data viewing window. The surface reflection is the place in time where the radar pulse leaves the antenna, and enters the subsurface. It can therefore be considered to be “time zero”, and its position should be at the top of the scan. When **Position** is set to Auto Mode, the system will attempt to identify the surface reflection and place it at the top of the data viewing window. The surface reflection is always a very strong reflection. The gain parameter should be set to **Auto** when using the Auto Position.

Note that the ability of the system to correctly identify the surface reflection depends upon the antenna selected and the ground conditions. It is important to check that the system has correctly identified the surface reflection. This is done by manually moving the scan down the viewing window by decreasing the range by a few nanoseconds. If the Auto Position has correctly identified the surface reflection, these data should be a nearly flat line (no signal) at the top of the scan above the surface reflection as you move the scan down the viewing window. If, as the scan is moved down the viewing window, more data appears above, then the Auto Position has not found the surface reflection. You should continue to move the scan down the window until the data becomes a nearly flat line at the top of the screen. The large reflection just below the flat data zone will be the surface reflection. The gain should be set to **Manual** when manually adjusting the scan position.

To manually move the data scan up or down in the window, set Position to **Manual**. A fourth column will appear which will allow you to move the scan. The Step parameter controls how much the scan is moved up and down and is changed using the *Right* → and *Left* ← arrow keys. Use the *Up* ↑ arrow key (increase time in ns) to move the data scan up in the window, and use the *Down* ↓ arrow key (decrease time in ns) to move the data scan down in the window. Gain should be set to **Manual** when manually adjusting the position. When using Manual signal position, keep the gains at a minimum when searching for the transmit pulse.

FILTERS

The filters command can be set to **Auto** or **Manual** by highlighting the command and pressing the *Enter* ↵ key. In Auto Mode the system estimates the center frequency of the data and sets the Vert HP (vertical high pass) filter to a frequency three octaves below and sets the Vert LP (vertical low pass) filter to a frequency one octave above the center frequency. The Hor Smooth filter is set to 3 scans and the Hor Bkgr RM is turned OFF.

Setting the Filters to Manual Mode cause a third column of filter parameters to appear, these are Vert HP, Vert LP, Hor Smooth and Hor Bkgr RM.

NOTE:

If you select a parameters setup file for your antenna, the filters will automatically be set and you should not be concerned with changing them unless you change antennas.

VERT LP

The Vert LP (vertical low pass) filter is used to eliminate high frequency noise (which appears as "snow") from the data. When this parameter is highlighted, a fourth column appears which allows you to set the value of this filter. The Vert LP filter is defined in terms of frequency in MHz.

The value of this parameter should be set according to the following formula:

VERT LP = ANTENNA CENTER FREQUENCY * 2

As the value of this filter is decreased, more filtering occurs and more data will be removed by the filter. This is a three pole IIR (Infinite Impulse Response) filter.

VERT HP

The Vert HP (vertical high pass) filter is used to eliminate low frequency noise (e.g., tilt) from the data. When this parameter is highlighted, a fourth column appears which allows you to set the value of this filter. The Vert HP filter is also defined in terms of frequency in MHz.

The value of this parameter should be set according to the following formula:

VERT LP = ANTENNA CENTER FREQUENCY / 6

As the value of this filter is increased, more filtering occurs and more data will be removed by the filter. This also is a three pole IIR filter. This filter **MUST** always be set when collecting data.

The Hor Smooth (horizontal smoothing) process filters the data horizontally, eliminating random noise and smoothing the data. This is an IIR running average filter and can help emphasize continuous layers. When this parameter is highlighted, a fourth column appears. The input value is number of Scans**.**

This filter is normally set to a value of 3. As the filter value is increased, more smoothing occurs and smaller targets are smoothed out of the data. If conducting rebar or utility

surveys this filter should be set no greater than 5. If you are looking for very small objects in the near subsurface (like wire mesh reinforcing in concrete), you should turn this filter off by setting it to zero. For subsurface layer mapping, the value of this parameter may be increased but is normally less than 20.

HOR BKGR RM

The Hor Bkgr RM (horizontal background removal) filter is used to improve the recognition of small targets and dipping reflectors.

This process filters the data horizontally by removing horizontal noise bands and reflecting layers. This filter **SHOULD NOT** be used in Data Collection Mode because it removes the surface reflection and any other real horizontal reflections.

When this parameter is highlighted, a fourth column appears. The input value is number of **Scans.** This is an IIR (infinite impulse response) running average subtraction filter. The filter works by taking an average of the data and subtracting the average from each scan. The smaller the selected filter value the more effect the filter has.

This filter is best used in playback when looking for point targets and there are significant horizontal noise bands. Use the *Cursor* to measure the width in terms of the number of scans of the largest point target and set the Hor Bkgr RM filter to this value. The filter will remove all horizontal banding that is equal to or longer than the set value of this parameter, provided there is no change in amplitude or depth of these horizontal signals.

SCAN

This menu item sets the parameters of the data scans. These parameters are samples/ scan, bits/sample and scans/second. **Scan** can be set to **Auto** (automatic) or **Manual** using the *Enter* ↵ key.

When in Auto Mode, the parameters are automatically set by the system. The samples/ scan will be set to 512, the bits/sample to 8 and the scans/second to 32, unless factory setups have been chose. In this case, the samples/scan and bits/sample may differ.

When in Manual Mode, the parameters, samples/scan, bits/sample and scans/second appear in the third column. The user can now manually set these parameters.

SAMP/SCAN

This parameter sets the number of data samples in a vertical scan. When it is highlighted, a fourth column appears which allows you to change the value of the parameter. The samp/scan can be set to 128, 256, 512, 1024, or 2048.

This value is normally set to 512 samples/scan which is the best value for most applications. However, for each antenna frequency there is a maximum value that the range should be set when recording 512 samples/scan and occasionally you may wish to set the range beyond this value. In this case you must increase the samples/scan to a higher value, otherwise your data will be under-sampled or aliased (i.e., resolution will be lost).

This maximum permissible range when recording 512 samples/scan is calculated by the following formula:

Maximum Range = (512 * 100) / (Antenna Center Frequency)

where the antenna center frequency is in Megahertz. For example, using the 500 MHz antenna:

Maximum Range = (512 * 100) / 500 = 102 nanoseconds

If using the 500 MHz and you decided to set the range beyond 102 nanoseconds, then the samples/scan should be increased to 1024 or 2048 if necessary.

The maximum permissible range for any given antenna and samples/scan (SS) value is calculated by:

Maximum Range = (SS * 100) / (Antenna Center Frequency)

One more example: For a 100 MHz antenna and 1024 samples/scan the maximum permissible range would be:

1024 nanoseconds = (1024 * 100) / (100)

If you wish to conserve disk storage space, you may wish to record 256 or 128 samples/scan. However, you must use the maximum range formula to ensure that you are not under-sampling your data. **Always** set your range first, then decide if you can use less than 512 samples/scan.

BITS/SAMPLE

The Bits/Sample parameter can be set to either 8 or 16 by toggling the *Enter* ↵ key.

The number of bits determines the dynamic range of the data. Data recorded at 16 bits has better dynamic range (i.e., the data can discriminate between two reflectors of small amplitude differences), but this will use twice the disk storage as 8 bit data.

If your survey objective is to find high amplitude targets such as metal, voids or highly reflective layer you should set **Bits/Sample** to 8. This will provide adequate dynamic range and save disk space.

If your survey objective is to map the various layers of the subsurface and they have a wide range of amplitudes, **and you plan on post-processing the data on a computer, you should set the number of bits to 16.**

SCANS/SECOND

This parameter controls the horizontal sampling rate along the ground when the system is in Continuous Mode. When Scans/Second is selected, a fourth menu column appears which will allow you to change the value. The possible values of this parameter depend upon the samples/scan setting selected. You should always set the Samples/Scan before the Scans/Second.

SAMPLESSCAN SETTING	SCANS/SECOND CHOICES
128	16,24,32,48,64
256	16,24,32,48
512	16,24,32
1024	16,24
2048	16

The normal setting is 32 scans/second. When surveying on foot at approximately 1 meter (3 feet) per second, a setting of 32 scans/second will result in a data scan about every 3 cm (1 inch) along the ground surface. If you wish to increase your scan density, you should walk slower. For example, a walking pace of 60 cm (2 feet) per second will result in a data scan approximately every 2 cm (1 inch) along the ground surface.

Often for large scale surveys (i.e., bedrock mapping), a coarser horizontal sampling is desired (ex. scans every 20 cm (8 inch)). In such cases, the scans/second value can be lowered to 24 or 16. This will result in smaller files, saving disk space and speeding up data transfer and post-processing.

Sometimes surveys are done pulling antennas with a vehicle at a higher rate of speed (ex. 2-5 meters (6-15 ft) per second). If a setting of 32 scans/second does not provide adequate horizontal sampling, you may increase the scans/second setting to 48 or 64. Note that scans/second settings of 48 and 64 are generally only available when the samples/scan are set to 128 or 256.

3.2.3 Setup Of Disk, Printer And Display Output Parameters

OUTPUT

When this command is highlighted, the Output Setup commands appear in the second column.

Pressing the *Enter* ↵ key when **Output** is highlighted will have no effect.

DISK

The hard drive storage device can be operated by highlighting the word **Disk** in the menu in the second row and toggling the **Disk On** or **Off** with the *Enter* ↵ key. If **Disk On** is selected, data will be stored to the hard disk, and the message “Out:D” will appear in the lower right corner of the screen. Each filename consists of the word FILE + a number (ex. FILE8), where the number increments for each file saved.

PRINT

This function turns the print output ON or OFF by using the *Enter* ↵ key. When it is turned ON, a third column of printer control commands appears. If the printer is not connected and turned ON, there will be a long delay (about a minute) when this parameter is selected.

PRINTER

Use this command to select the printer you will be using to print the data. The *Enter* ↵ key is used to toggle between the two selections, the GS-608P and the DPU5400.

HORIZONTAL ZOOM

This parameter stretches the data printout in the horizontal direction. The possible values are 1, 2, 3, or 4 and the *Enter* ↵ key is used to change the value.

A value of 1 means that each scan of a data file is printed as one scan on the printer. A value of 2 means that each scan of a file is output as 2 duplicate scans on the printer. A value of 3 means that each scan of a file is output as 3 scans on the printer and a value of 4 means 4 scans are printed for each scan in a data file.

When in Linescan Mode, the DPU5400 and the GS-608P print 200 and 203 scans per inch respectively. The SIR-2 video display displays 94 scans per inch. A horizontal zoom setting of 2 will give the best match between the video screen and the printout.

ORIENTATION

This parameter controls the orientation of the data as it is printed on the paper. The orientation can be Normal or Flipped (vertically) and is changed by pressing the *Enter* ↵ key.

In the Normal setting the top of the data will print at the top of the paper. In the Flipped setting the top of the data will print at the bottom of the paper.

This is useful when adjacent survey lines are collected in opposite directions. When the direction of data collection is reversed and the data printout is set to Flipped, you will be able to easily align all the printouts and compare adjacent features. For example, if the odd numbered survey lines (1,3,5,7...) are collected from East to West and printed Normal, and the even number survey lines (2,4,6,8...) are collected from West to East and printed Flipped, you will be able to align all printouts and compare features.

⚠ CAUTION:

The Scans/Second parameter must be set to 32 or less when printing data during acquisition. The Horizontal Zoom must be set to 1 when printing data during acquisition.

DISPLAY

This command controls how the data is displayed to the video screen. There are three types of data display; Linescan, Wiggle, and O-Scope. Use the *Enter* ↵ key to toggle through the three types of displays. When the display type is changed, the appropriate display parameters to be set appear in the column three.

Using the Linescan display, the reflected radar signal is mapped by amplitude and polarity to different colors or shades of gray. A color scale of 16 colors is used. Eight colors represent positive amplitudes and eight colors represent negative amplitudes. Each level of signal in a scan is assigned a color depending upon its amplitude. Each scan results in a vertical line of colored (or gray-shaded) dots on the SIR-2 screen. As each scan is collected by the system the screen fills with vertical, colored lines to generate a profile image of the subsurface.

The Linescan color display is the best display for most applications, especially good for identifying buried point targets (ex. drums, voids, pipes). The Linescan grayscale display is a good display to identify buried pipes. The Linescan color or gray shade displays are also good for displaying geologic layering. You should try different Linescan color and grayscale displays of the same data sets to determine which displays help you best with the interpretation.

Wiggle displays are sometimes better for interpreting layering in stratigraphic or geological surveys over long distances.

Oscilloscope display allows viewing of a single radar trace in detail.

LINESCAN DISPLAY PARAMETERS

COLOR TABLE

This parameter sets the Color (or gray scale) Table to be used to display the data. There are 15 possible Color Tables from which to choose. The *Enter* ↵ key is used to change the Color Table by toggling through the choices. The active Color Table is shown in the upper right hand corner of the SIR-2 screen, above the oscilloscope display.

Each Color Table consists of 16 colors, eight colors to represent positive amplitudes and eight colors to represent negative amplitudes. Each data point in a scan is represented by a color or gray shade depending upon its value. For example, using Color Table 2 low amplitude data values will show as black, high positive amplitudes as white and high negative amplitudes as gray. Thus, each scan results in a vertical line of colored (or gray shaded) dots on the SIR-2 screen. As each scan is collected by the system, the screen fills with vertical colored (or grayscale) lines to generate a profile image of the subsurface.

The Linescan color display is a good display for most applications, but it is especially good to identify buried point targets (ex. drums, voids, pipes). The Linescan grayscale display is a good display to identify buried pipes.

COLOR XFORM

This parameter sets the Color Xform (i.e., Transform) to be used to display the data. There are 8 possible Color Transforms from which to choose. The *Enter* ↵ key is used to change the transform. The active Color Transform is shown in the upper right hand corner of the SIR-2 screen.

The Color Transform determines whether the color scale applied to the radar signal's amplitude is linear, logarithmic, or exponential. This function can also be used to de-emphasize certain features. For example, in a logarithmic display, all low amplitude signals are assigned into a "compressed" lower color range, and the range of high amplitude signals is extended. If white represents a high amplitude signal, then there will be more white area for a given data set than a linear transform. Transforms 2 and 3 are used to emphasize weak reflections, and Transforms 4 and 5 are used to emphasize high amplitude reflections.

During system setup you should always use Color Xform 1**, which is linear**. Though not required, we recommend using Color Xform 1 when collecting data.

During data playback Color Xform 2 is useful when viewing low amplitude regions and Color Xform 4 is useful when the objective is high amplitude targets (i.e., metal, or voids).

VERT SCALE

This parameter controls the Vertical Scale labeling. The Vertical Scale can be set to Time, Depth Or None. If **None** is selected, no vertical scale will be printed. If set to **Time,** the vertical scale will be two-way travel time in nanoseconds.

If set to **Depth,** the vertical scale will be in meters below the surface. Note that the depth scale is only approximate, and is based on an assumed dielectric constant of the subsurface for a single layer model. See the Diel parameter help for details. Note that the default Diel value is 1.

DIEL

This parameter is the value of the dielectric constant used to convert two-way travel time to depth. The value ranges from 1 to 81 and depends upon the dielectric properties of the subsurface materials being profiled.

WARNING: Dielectric constants for various materials, and thus the resulting depth scales, are only approximations. For a description of methods for estimating the dielectric constant of the subsurface at your site, see your training notes.

Approximate dielectric constants for various materials follow:

Material	Dielectric Constant	Material	Dielectric Constant
Air	1	Wet Granite	6.5
Snow Firn	1.5	Travertine	8
Dry Loamy/Clayey Soils	2.5	Wet Limestone	8
Dry Clay	4	Wet Basalt	8.5
Dry Sands	4	Tills	11
Ice	4	Wet Concrete	12.5
Coal	4.5	Volcanic Ash	13
Asphalt	5	Wet Sands	15
Dry Granite	5	Wet Sandy Soils	23.5
Frozen Sand & Gravel	5	Dry Bauxite	25
Dry Concrete	5.5	Saturated Sands	25
Dry Limestone	5.5	Wet Clay	27
Dry Sand & Gravel	5.5	Peats	61.5
Potash Ore	5.5	Organic Soils	64
Dry Mineral/Sandy Soils	6	Sea Water	81
Dry Salt	6	Water	81
Frozen Soil/Permafrost	6		
Syenite Porphyry	6		
Wet Sandstone	6		

WIGGLE AND O-SCOPE DISPLAY PARAMETERS

SCALE

The scaling parameter defines the number of vertical lines used to represent each wiggle. The larger the scale value, the larger the wiggle representation.

In O-Scope Mode, the scaling parameter defines the section of the amplitude scale observed. When Scale is 1, the full amplitude scale is shown. When Scale is 2, only the bottom 50% of the amplitude scale is shown. When Scale is 3, only the bottom 30% of the amplitude scale is shown, etc. Increasing the Scale parameter allows one to progressively zoom in on the scan.

HOR SCALE

This parameter controls the Horizontal Scale labeling when in O-Scope Display Mode. The Horizontal Scale can be set to Time, Depth or None. If **None,** no horizontal scale will be printed in the Wiggle Mode, but a time scale will be printed in O-Scope Mode. If set to **Time,** the horizontal scale will be two-way travel time in nanoseconds.

If set to **Depth,** the horizontal scale will be in meters below the surface. Note that the depth scale is only approximate, based on the ASSUMED dielectric constant of the subsurface. See the DIEL parameter help for details.

SPACE

The spacing parameter sets how many vertical lines to move before printing the next wiggle. The higher the spacing value, the larger the spacing between wiggles.

STACK

The stacking refers to the number of incoming scans to stack for printing and display. This stacking does not apply to the recorded data. For example, a stack=4 will stack incoming scans into one (1) output scan for printing and display.

SKIP

Skip refers to the number of scans to skip for printing and display. This will have no effect on the scans recorded. For example, a skip=1 will skip every other scan for printing and display. A skip of 2 will print a scan, skip two scans and print the next scan.

3.3 Saving The System Parameter Settings For Future Use

After setting up the system operating parameters, you may wish to save the setting for future use. This is done by using the **Save Setup** command accessed from the **Setup** command in the COLLECT SETUP MENU block or the PLAYBACK SETUP MENU block. This command is at the bottom of the second column of commands.

SAVE SETUP

This command allows you to save all of the current system settings into a setup file. This file can then be recalled any time in the future and the system will be set to the current

settings. Settings files can be recalled at any time using the **Recall Setup** command (see Section 2.6 for details).

When this command is highlighted and the *Enter* ↵ key pressed, a list of 56 possible setup files will be displayed on the screen. Use the *Arrow* ←↑↓→ keys to highlight the setup number where you wish to save the current settings. Press the *Enter* ↵ key to save the settings.

SHOW SETUP

This command shows the current system settings.

CHAPTER 4: DATA COLLECTION

4.1 Preparing For Data Collection

After setting the operating system parameters, either automatically (see Sections 2.6 and 3.1) or manually (see Chapter 3), you are ready to collect data. As a reminder, we have listed below three critical parameters that you should verify:

- Is the **Disk Output** set to ON?
- Have you selected the correct Run Mode, either **Con**t (continuous), **SW** (survey wheel) or **Point** (point collection)? If you are using a survey wheel, has it been calibrated?
- If you are going to print data real-time, have you selected the correct printer and set **Print** to ON?

The COLLECT DATA MENU block is entered by pressing the *Run/Standby* key. What you see on the screen will depend upon the Run Mode you set.

- If the Run Mode is set to **Cont** (continuous), the system will begin collecting data and it will show across the screen. The file and scan number will appear in the lower right corner of the screen.
- If the Run Mode is set to **SW** (survey wheel), a scan will appear on the left end of the screen and the rest of the screen will remain blank until you begin to move the antenna/survey wheel.
- If the Run Mode is set to **Point** (point collection), a scan will appear on the left end of the screen. The rest of the screen will remain blank until you press the *Run/Standby* key or the marker to begin collect the next data point or survey station.

Section 4.2 describes continuous data acquisition and the parameters in the COLLECT DATA MENU block.

Section 4.3 will describe operation in the survey wheel controlled method and Section 4.4 will describe operation with the discrete data point method.

NOTE:

All users should read section 4.2.

4.2 Continuous Data Collection Method

The antenna is pulled continuously across the ground and the SIR-2 collects data at the number of scans per second selected. The data collection rate is independent of the speed at which the antenna is pulled. The resulting subsurface profile is referenced to a ground

location via the operator placing electronic marker events on the data as the antenna crosses survey grid points.

- Start collecting data by pressing the *Run/Standby* key or a marker switch connected to your antenna once. Each subsequent pressing of the switch will place a mark in the radar record. Pressing the *Up Arrow* key on the control unit will also generate marks.
- To stop collecting data at the end of a survey line press the *Run/Standby* key. The system will now be in standby mode and the data for that line can be reviewed.

To stop collecting data, close the data file and start another line, press the *Run/Standby* key and **HOLD IT DOWN FOR 2 SECONDS**. Note that this method of closing the file can only be done when the system is collecting data. If the system is in Standby, you must first press *Run/Standby* to begin collection, then press *Run/Standby* and hold it down for 2 seconds. A file may also be closed while in Standby if the *Enter* key is pressed (to bring up menu), then select **Go To Setup**.

- When the *Run/Standby* key is pressed to begin data collection, the speaker will emit a single BEEP. When a data file is closed, the speaker will emit a double BEEP.

To stop collecting data from the antenna marker, press and hold the *Marker* button for 2 seconds to close the data file. The system is now ready to begin collecting the next data file.

REVIEWING THE CURRENT DATA FILE BY SCROLLING

If the current data file is greater than one screen, the data file (up to the limit of the system memory) can be reviewed using the SIR-2 scroll capability. Press the *Run/Standby* key to put the system in Standby. Use the *Right* arrow key to view data to the left of the current data screen and use the *Left* arrow to view data to the right of the current data screen.

THE COLLECT DATA MENU COMMANDS

This menu must be accessed after data collection has begun. During data collection, press *Run/Standby* to enter Standby, then press *Enter* to bring up the menu.

COLLECT

Selecting this command will start the system collecting data. The output device, either a Disk File number or RAM will be shown in the bottom right hand corner of the screen as the data is collected.

CURSOR

When Cursor is activated, dashed cross-hairs appear on the screen. The horizontal line gives the time-depth of an object in nanoseconds (ns) if the Vert Scale Display parameter is set to time. If the Vert Scale Display parameter is set to **Depth**, the horizontal line gives the depth of an object in meters.

2D GRID

This function is not operational at this time.

When 2d Grid is operational, this parameter is the line number that will be entered into the file header for the next line of data to be acquired.

STARTP

When 2d Grid is operational, this parameter is the Y coordinate value for the starting point of the line.

ENDP

When 2d Grid is operational, this parameter is the Y coordinate for the ending point of the line.

MARK INTVL

When 2d Grid is operational, this parameter is the Y coordinate interval between marker (survey grid) locations along the line.

STEP

For the parameter shown in the box above, this is the increment that will be used when changing the value of the parameter.

After the desired value of the parameter is set, press the *Enter* ↵ key to register that value in the system.

SELECT BLOCK

This command is used to select a block of data for printing or saving to disk. The block of data selected can be more than one screen size. When this command is selected, the command menu will disappear from the screen and a vertical line (cursor) will appear in the middle of the screen. Move the cursor using the *Right* → and *Left* ← arrow keys until it is on the first (leftmost) scan of the block of data you want to select. Press the *Down* ↓ arrow key to select the beginning of the block. Now, using the *Right* → arrow key, move the cursor until it is on the last (furthest to the right) scan of the block of data you wish to select. As you move the cursor, a cross-hatched diagonal highlighted area will appear over the data that will be selected. Press the *Up* ↑ arrow key to complete the selection. Press the *Print* 🖶 key to print the selected data block. Press *Enter* ↵ and then select **Dump To File** to save the selected block in a file. If **Disk On** is selected, data will be stored to the file with name FILENAME+L (a letter A-Z will be appended to the original file name), otherwise a file name with a number greater than the last file number recorded will be created. Press the *Enter* ↵ key to exit the **Select Block** function.

DUMP TO FILE

This command enables you to save a selected block to a separate data file. After a block of data has been selected, highlight the **Dump To File** command and press *Enter* ↵.

DROP MENU

This command will cause the command menu to disappear, so the bottom of the data can be viewed.

GO TO SETUP

Selecting this command will put the system in the Collect Setup Mode, and close the current file.

4.3 Survey Wheel Controlled Data Collection Method

In this mode of operation a survey wheel attached to an antenna controls the scanning of the SIR-2 system. Parameters are set so that data are acquired at fixed intervals. *This is the most accurate survey method.*

Start collecting data by pressing the *Run/Standby* key or a marker connected to your antenna. Start pulling the antenna along the survey line and data will begin to appear on the screen. If you stop pulling the antenna data will stop being collected. DO NOT BACK UP the antenna because this will cause your survey distance to be incorrect. Continue pulling the antenna until the end of the survey line. To stop collecting data at the end of a survey line press the *Run/Standby* key. The system will now be in standby mode and the data for that line can be reviewed. To close the data file and start another line press the *Run/Standby* key and hold it down for 2 seconds.

To stop collecting data from the antenna marker, press and hold the *Marker* button for 2 seconds and close the data file. The system is now ready to collect the next file.

NOTE:

If the system speaker sounds a continuous BEEPing sound while collecting data with a survey wheel, you are pulling the antenna too fast. Either slow down your rate of acquisition, decrease the Scans/Unit value in the survey wheel setup, or increase the scan rate in Collect Data Setup.

4.4 Discrete Data Point Data Collection Method

There are certain field situations where the continuous mode data collecting method is not practical, and it is only possible to collect data with the point-by-point method. Two such situations are: data collection in mines where the walls are not flat, and in heavily overgrown field sites such as many landfills. Also, in cases where deep penetration is necessary, or in conductive subsurface conditions, it is sometimes advantageous to use the discrete data point collection method with large stacking values.

Start collecting data by pressing the *Run/Standby* key or a marker connected to your antenna. The system will output one scan and then standby. Move the antenna to the next station and press the *Run/Standby* key or the antenna marker key to collect a scan at

that station. Continue this collection technique until the end of the survey line. To stop collecting data at the end of a survey line press the *Run/Standby* key and hold for 2 seconds at the last station. This will close the file and the system will be ready for the next survey line.

NOTE:

The antenna marker switch cannot be used to close the data file at the end of a line in point mode. You must use the *Run/Standby* key to close the file in this mode. This is done by holding the *Run/Standby* key depressed for 2 seconds at the last station on the line.

CHAPTER 5: DATA PLAYBACK AND REVIEW

Selection of files to playback and setup of system display, processing and output during playback are done in the PLAYBACK SETUP MENU block. Playback of data already collected and stored on the disk is done via the PLAYBACK DATA MENU block.

5.1 Playback Setup Menu Block

This block is entered when the system is powered ON without an antenna, or from the PLAYBACK DATA MENU block by entering the **Setup** command. It is entered from the COLLECT SETUP MENU block by pressing the *Collect/Playback* key.

5.1.1 Setup For Processing Of Playback Data

During playback, Gains, Horizontal Filters and Vertical Filters can be applied to the data to improve interpretation.

SETUP

When this command is highlighted, a set of playback processing parameters that can be set appears in the second column. The commands that will appear in the second column are; **Processing, Play All, Save Setup, Recall Setup,** and **Show Setup.**

Pressing the *Enter* key when **Setup** is highlighted will have no effect.

When **Processing** is highlighted, the following options appear in a menu box to the right:

GAIN

This function is used to apply an additional gain constant to the data files as they are played back to the system or transferred to a computer. You can apply this gain if the data acquired is too low in amplitude and difficult to interpret.

Activating this function will cause a parameter setup box to appear to the right. Use this box to adjust the value of the gain to be applied.

When setting the values of the gain, the *Up* arrow is used to increase the value of the parameter and the *Down* arrow is used to decrease the value of the parameter. The *Right* and *Left* arrows are used to increase or decrease the increment when setting the gain values. The gain values are in units of decibels (dB). Every 6 decibel increase is equivalent to doubling the amplitude of all points in the signal.

CAUTION:

Gains applied to the data during playback are not stored in the data file. They are only applied to the displayed data. When gains are applied to the data during playback and data transfer is ON, or DISK=ON, the data stored on the receiving computer or the internal hard disk will have this additional gain applied. The internal hard disk file will have a letter appended to the original file name.

FILTERS

When this command is highlighted, a series of data filter commands will appear in the third column. The filters are: Vert HP (vertical high pass), Vert LP (vertical low pass), Hor Smooth (horizontal smoothing), and Hor Bkgr Rm (horizontal background removal). These filters are used to improve signal clarity. For more details on filters see Section 3.2.2.

The Vert HP (high pass) filter is used to eliminate low frequency noise (i.e. signal drift).

The Vert LP (low pass) filter is used to remove high frequency noise ("snow").

The Hor Smooth (horizontal smoothing) filter is used to horizontally smooth the data (enhances layers).

The Hor Bkgr Rm (horizontal background removal) is used to improve the recognition of small targets by removing horizontal bands produced by noise, reverberations or flat reflecting layers.

The units of the vertical filters are in MHz and the horizontal filters are numbers of scans.

CLR PROC

When this command is highlighted and activated by pressing the *Enter* ↵ key, any data playback processing set (i.e., Gain and Filters) will be reset to zero and turned off. There will be no additional data processing during playback.

PLAY ALL

When this command is selected, all data files stored on the hard drive will be played back to the display and printed, if a printer is connected to the SIR-2 and turned ON. This option allows the user to print all the files while the system is unattended.

SAVE SETUP

This command allows you to save the current playback setup in a file you designate (SETUP_1 to SETUP_56) for future use.

RECALL SETUP

Allows you to recall previously saved system setups.

SHOW SETUP

Displays the current system setup parameters.

5.1.2 Data Display And Printing During Playback

There are three types of displays available during playback, Linescan, Wiggle and O-Scope. These displays can be printed during playback on the DPU-5400 (Seiko Model DPU5400 4" thermal plotter) or the GS-608P (OYO Model GS-608P 8" thermal plotter).

OUTPUT

When this command is highlighted, the output setup commands appear in the second column. Pressing the *Enter* ↵ key when **Output** is highlighted will have no effect.

PRINT

This function turns the print output ON or OFF by pressing the *Enter* ↵ key. When it is turned ON, a third column of printer control commands appears.

DISK

Disk ON writes the playback file to the hard drive and appends a letter to the filename each time the file is saved.

XFER

See Section 7.3.1.

PRINTER

Use this command to select the printer you will be using to print the data. The *Enter* ↵ key is used to toggle between two selections, the OYO Model GS-608P 8" thermal plotter, and the Seiko Model DPU5400 4" thermal plotter. Make sure the printer cable is connected and the printer turned ON before selecting the printer.

The maximum real-time scan rate when printing is 32 scans/sec.

HORIZONTAL ZOOM

This parameter stretches the data printout in the horizontal direction. The possible values are 1, 2, 3, or 4 and the *Enter* ↵ key is used to change the value.

A value of 1 means that each scan of a data file is printed as one scan on the printer. A value of 2 means that each scan of a file is output as 2 duplicate scans on the printer. A value of 3 means that each scan of file is output as 3 scans on the printer and a value of 4 means 4 scans are printed for each scan in a data file.

When in Linescan Mode the DPU5400 and the GS-608P print 200 and 203 scans per inch respectively. The SIR-2 video display displays 94 scans per inch. The Horizontal Zoom setting of 2 will give the best match between the aspect ratio of the video screen and that of the printout.

ORIENTATION

This parameter controls the orientation of the data as it is printed on the paper. The orientation can be Normal or Flipped and is changed by pressing the *Enter* ↵ key.

In the Normal setting, the top of the data will print at the top of the paper. In the Flipped setting, the top of the data will print at the bottom of the paper.

This feature is useful when adjacent survey lines are collected in opposite directions. When the direction of data collection is reversed and the data printout is set to **Flipped,** you will be able to align all the printouts and compare adjacent features. For example, if the odd-numbered survey lines (1,3,5,7...) are collected from East to West and printed Normal, and the even-numbered survey lines (2,4,6,8...) are collected from West to East and printed Flipped, you will be able to align all printouts in their proper perspective and compare features.

DISPLAY

This command controls how the data is displayed on the video screen and printer. There are three types of data display; Linescan, Wiggle, and O-Scope. Use the *Enter* ↵ key to toggle through the three types of displays. When the display type is changed, the appropriate Display parameter menus requiring input appear in the column three.

COLOR TABLE

This parameter is only used when Display=**Linescan**.

This parameter sets the color (or gray scale) table to be used to display the data. There are 15 possible Color Tables from which to choose. The *Enter* ↵ key is used to toggle through the color table choices. The active Color Table is shown in the upper right hand corner of the SIR-2 screen.

Each color table consists of 16 color bins, eight colors to represent increasing positive amplitudes and eight colors to represent increasing negative amplitudes. Each data point in a scan, depending upon its amplitude value, is represented by a color or gray scale. For example, using Color Table 2, low data amplitudes will show as black, high positive amplitudes as white and high negative amplitudes as gray. Thus, each scan results in a vertical line of colored (or gray shaded) dots on the SIR-2 screen. As each scan is collected by the system, the screen fills with vertical colored (or grayscale) lines to generate an image profile of the subsurface.

The Linescan Color display is the best for most applications, and especially good to identify buried point targets (ex. drums, voids, pipes). The Linescan Grayscale display is good to identify buried pipes.

COLOR XFORM

This parameter only used when Display=**Linescan.**

This parameter sets the Color Xform (i.e., Transform) to be when displaying data. There are 8 possible Color Transforms from which to choose. The *Enter* ↵ key is used to change the transform. The active Color Transform is shown in the upper right hand corner of the SIR-2 screen.

Different Color Transforms will emphasize different amplitude aspects of the data. Compare Color Xform 3, which emphasizes the low data amplitudes and will represent

the data with multiple colors, with Color Xform 5, which emphasizes the high data amplitudes and will decrease the amount of color representing the data.

During system setup you should always use Color Xform 1 (linear). We also recommend using Color Xform 1 when collecting data.

During data playback Color Xform 2 is useful when viewing low amplitude regions and Color Xform 4 is useful when the objective is to see only high amplitude targets (i.e., metal, or voids).

VERT SCALE

This parameter controls the vertical scale labeling. The vertical scale can be set to Time, Depth or None. If **None** is selected, no vertical scale will be printed. If set to **Time,** the vertical scale will show two-way travel time in nanoseconds.

If set to **Depth,** the vertical scale will display meters below the surface. Note that the depth scale is only approximate, and based on an *assumed* dielectric constant value for the subsurface. See the Diel parameter help for details.

DIEL

This parameter is the value of dielectric constant used to convert two-way travel time to depth. The value can range from 1 to 81 or more and varies greatly with electrical and physical properties of the subsurface materials. Note: The default dielectric value for a depth scale is 1. Be sure to select an appropriate dielectric value before collecting/playing back data.

WARNING: Dielectric constant values for various materials and the resulting depth scales are only approximations. For a description of methods for estimating the dielectric constant of the subsurface at your site, see your training notes.

Approximate dielectric constants for various common materials follow:

Material	Dielectric Constant	Material	Dielectric Constant
Air	1	Wet Granite	6.5
Snow Firn	1.5	Travertine	8
Dry Loamy/Clayey Soils	2.5	Wet Limestone	8
Dry Clay	4	Wet Basalt	8.5
Dry Sands	4	Tills	11
Ice	4	Wet Concrete	12.5
Coal	4.5	Volcanic Ash	13
Asphalt	5	Wet Sands	15
Dry Granite	5	Wet Sandy Soils	23.5
Frozen Sand & Gravel	5	Dry Bauxite	25
Dry Concrete	5.5	Saturated Sands	25
Dry Limestone	5.5	Wet Clay	27
Dry Sand & Gravel	5.5	Peats	61.5
Potash Ore	5.5	Organic Soils	64
Dry Mineral/Sandy Soils	6	Sea Water	81
Dry Salt	6	Water	81
Frozen Soil/Permafrost	6		
Syenite Porphyry	6		
Wet Sandstone	6		

WIGGLE AND O-SCOPE DISPLAY PARAMETERS

SCALE

The scaling parameter defines the number of vertical lines used to represent the amplitude of each wiggle. The larger the scale value, the larger the wiggle representation.

In O-Scope Mode, the scaling parameter defines the section of the amplitude scale observed. When Scale is set to 1, the full amplitude scale is shown. When Scale = 2, only the bottom 50% of the amplitude scale is shown. When Scale = 3, only the bottom 30% of the amplitude scale is shown, etc.. Increasing the Scale parameter allows one to progressively zoom in on the scan.

HOR SCALE

This parameter controls the horizontal scale labeling when in O-Scope Display mode. The horizontal scale can be set to Time, Depth or None. If **None** is selected, no horizontal scale will be printed in wiggle display, time lines will be printed in O-Scope display. If set to **Time**, the horizontal scale will be two-way travel time in nanoseconds.

If set to **Depth,** the horizontal scale will be in meters below the surface. Note that the depth scale is only approximate, based on the assumed dielectric constant of the subsurface. See the Diel parameter help for details.

SPACE

The spacing parameter determines how many vertical line spaces to skip before printing the next wiggle. The higher the spacing value, the larger the spacing between wiggles. This function will have the effect of lengthening a radar profile.

STACK

Stacking refers to the number of incoming scans to stack (add) for print and display purposes only. Stacking does not apply to the recorded data. For example, setting Stack = 4 will stack 4 incoming scans into one (1) output scan for printing and display. This function will have the effect of shortening a radar profile.

SKIP

Skip refers to the number of scans to skip for print or display purposes only. This will have no effect on recorded data. For example, a Skip = 1 will skip every other scan for printing and display. A Skip of 2 will print (display) a scan, skip two scans and print (display) the next scan. This function will have the effect of shortening a radar profile.

5.1.3 Selecting Files For Playback

Activate the **Files** command and then from the second column choose **Select** or **Select All** (the **Select All** command is at the bottom of the second column). The **Select** command allows you to choose individual files or groups of files to playback. This is accomplished by highlighting the file or files you want to playback with the cursor, and then pressing the *Enter* ↵ key. This action will place a box around the file(s) you have selected, and the SIR-2 will play them back when the *Run/Standby* ⊡ is pressed. The first time the *Run/Standby* ⊡ key is pressed, the file header will be displayed. The second time the *Run/Standby* ⊡ key is pressed, the file will play back. If the file is longer than one screen, you can scroll back and forth through the file using the *Right* → and *Left* ← arrow keys. The **Select All** command will select all files on the disk for playback.

5.2 Playback Data Menu Block

This block is entered from the COLLECT DATA MENU block by pressing the *Collect/ Playback* key. It is entered from the PLAYBACK SETUP MENU block by pressing the *Run/Standby* ⊡ key.

REVIEWING THE CURRENT DATA FILE BY SCROLLING

If the current data file size is greater than one screen, the data file (up to the limit of system memory) can be reviewed using the SIR-2 scroll capability. Press the *Run/Standby* ⊡ key to put the system in Standby. Use the *Right* → arrow key to view data to the left of the current data screen and use the *Left* ← arrow to view data to the right of the current data screen.

THE PLAYBACK DATA MENU COMMANDS

PLAYBACK

This toggle command will alternatively display the current file header on the screen or clear the data section of the screen.

CURSOR

When **Cursor** is activated, a dashed cross-hairs appears on the screen. The horizontal line gives the two-way travel time from the beginning of the scan to the object in nanoseconds (ns) if the Vert Scale display parameter is set to **Time**. If the Vert Scale display parameter is set to **Depth,** the horizontal line gives the depth of an object in meters.

> ⚠ **CAUTION:**
>
> The measurement of two-way travel time or depth assumes that the surface reflection is at the top of the data screen. If it is not then the measurements will be incorrect.

VIEW

This function controls the data viewing on the screen. It has four settings; Full, Upper, Middle, and Deep. It does not affect the recorded data. Use the *Enter* ↵ key to toggle through the views. The **Full** view displays the full data scan on the screen. The **Upper** view displays the upper third of the data on the full screen. It is a zoom view on the shallow data. The **Middle** view displays the middle third of the data on the full screen. It is a zoom view on the middle section of data. The **Deep** view displays the bottom third of the data on the full screen. It is a zoom view on the bottom third of data.

For example: If a range of 120ns was set, the Full view would display 0-120ns, the Upper view would display 0-40ns, the Middle view would display 40-80ns and the Deep view would display 80-120ns. Note that the cursor coordinates refer to the last view selected. For example, if the first half of the screen is the full view and the last half is the deep view, the cursor will assume the range for the deep view over the entire screen.

SELECT

This command is used to select or deselect files to be played back by the system for review. When this command is activated, a list of data files will appear on the upper portion of the screen. Using the *Arrow* ←↑↓→ keys and the *Enter* ↵ key to select the files that you wish to playback for review.

SELECT BLOCK

This command is used to select a block of data for printing or saving to disk. The block of data selected can be more than one screen size. When this command is selected, the command menu will disappear from the screen and a vertical line (cursor) will appear in the middle of the screen. Move the cursor using the *Right* → and *Left* ← arrow keys until it is on the first (left-most) scan of the block of data you want to print. Press the *Down* ↓ arrow key to select the beginning of the block. Now using the *Right* → arrow key, move

the cursor until it is on the last (right-most) scan of the block of data you wish to print. As you move the cursor, a cross-hatched diagonal highlight box will appear over the data that you select. Press the *Up* ↑ arrow key to input the end of the block you are interested in. Press the *Print* key to print the selected data block, or use the **Dump To File** command to save the selected block into its own file. If **Disk On** is selected, data will be stored to the file with name FILENAME+L (a letter A-Z will be appended to the original file name), otherwise a new file name with one higher number than the last file name will be created. Press the *Enter* ↵ key to exit the **Select Block** function.

DUMP TO FILE

This command enables you to save a selected block to a separate data file. After a block of data has been selected, highlight the **Dump To File** command and press *Enter* ↵.

DROP MENU

This command will cause the command menu to disappear, allowing the bottom of the data to be viewed.

GO TO SETUP

When the system is in the Collect Data Mode, selecting this command will put the system in the collect setup mode. When the system is in the Playback Data Mode, selecting this command will put the system in the Playback Setup Mode.

CHAPTER 6: OPERATION WITH THE GSSI DPU-5400 AND GS-608P THERMAL PLOTTERS

Two thermal printers the DPU-5400 and the GS-608P can be used with the SIR-2 control unit to provide field prints of your data. Data can be printed either in real-time (i.e., during acquisition) or during playback from disk.

NOTE:

Because of the high data acquisition rate of the SIR-2, only the GSSI DPU-5400 and GS-608P printers can be used with the SIR-2. Other printers are not supported.

After turning on the SIR-2, connect one end of the SIR-2 printer cable to the parallel connector of the SIR-2 and the other end to the printer. The connector is on the underside of the DPU-5400 and on the topside of the GS-608P. Turn the printer ON.

1. From the COLLECT SETUP MENU block, select **Output** and then turn **Print** to **ON**.
2. Select the **Printer** type, either DPU5400 or GS-608P.
3. Set the **Horizontal Zoom** to 1 if printing during data collection. The Horizontal Zoom can be set to other values if printing during data playback.
4. Set the **Orientation** to Normal.
5. Enter the COLLECT DATA or PLAYBACK DATA MENU blocks and collect or playback data. The data will now be printed.

NOTE:

The printer should not be connected during power-up of the SIR-2. If the SIR-2 seems to hang-up during the power-up sequence, disconnect the printer (or parallel data transfer) cable.

Chapter 7: File Operations - Compress, Delete & Transfer

In order to keep the SIR-2 disk working efficiently during data collection, it is important to effectively manage the disk files. Data file compression, decompression, deletion, and transfer to a computer are accessed from the **Files** command in the first column of the PLAYBACK SETUP MENU block or the COLLECT SETUP MENU block.

NOTE:

If you wish to compress, delete or transfer all the disk files, or a majority of the files, you should first activate the **Select All** command at the bottom of the second column of the **File** commands.

7.1 File Compression To Save Disk Space

Compression commands are accessed from the **Files** command in the first column of the PLAYBACK SETUP MENU block or the COLLECT SETUP MENU block.

COMPRESS

Compress data files to save room on the data storage disk or to make them smaller for data transfer. When the highlight bar is moved to this command two compression commands appear in the third column, **Method** and **Do Compress**.

METHOD

There are four possible compression methods, 16-8 (16 bit data resample to 8 bit data), Resamp (saves every other data sample), Rescan (saves every other data scan) and Stat (variable 4-16 bit resample). The 16 to 8 resampling will compress 16 bit files by about 50% , but it will not compress 8 bit data files. The other methods will compress all data files by approximately 50% or more. After a file is compressed, you cannot recover the original file unless you choose to save it during the compression.

Rescan and Resamp compression take approximately 1 minute per megabyte of data. The 16-8 compression takes approximately 45 seconds per megabyte of data.

DO COMPRESS

When this command is activated, the directory of stored data files appears on the screen. Select the files you wish to compress, or all files, and then begin the compression. You will be asked if you want to store the original data files. If the answer is YES, the original files are saved under the original name and the new files are saved as FILENAME+_0 or FILENAME+0 (a _0 or 0 is added to the original file name). If more than one compression is done, -1, -2, -3... will be appended to the file name rather than -0.

7.2 Deleting Data Files To Save Disk Space

The Delete command is accessed from the **Files** command in the first column of the PLAYBACK SETUP MENU block or the COLLECT SETUP MENU block

DELETE

When this command is activated, the directory of stored data files appears on the screen. Select the files you wish to delete and then begin the deletion process by pressing the *Run/Standby* key. You will be asked to confirm deletions.

7.3 Transferring Data Files From The SIR-2 To A Computer

The file transfer command (**Transfer)** is accessed from the **Files** command in the COLLECT SETUP MENU block or the PLAYBACK SETUP MENU block.

On the software utilities disk provided with your SIR-2, there is a program named SIR2FTR.EXE. Copy this program to the directory on your computer where you want to store the transferred data files. To transfer data to a computer, you must first connect the SIR-2 parallel data transfer cable from the SIR-2 PARALLEL connector to an enhanced **bi-directional** parallel port (EPP) in the computer. BOTH THE COMPUTER AND SIR-2 MUST BE TURNED ON BEFORE CONNECTING THE PARALLEL DATA TRANSFER CABLE. Simple to install, bi-directional parallel port computer cards are available from GSSI.

WARNING

The SIR-2 parallel data transfer cable should only be connected to an enhanced bi-directional parallel port (EPP) in your computer. The parallel ports of most computers are output only. If you connect the parallel data transfer cable to an output only parallel port on your computer, damage will occur to the computer parallel port. If you are uncertain that your computer has a bi-directional parallel port, do not connect the cable and try it. Refer to your computer manual or call your computer sales representative. GSSI is not responsible for any damage that occurs to computer parallel ports.

Simple to install, enhanced bi-directional parallel port (EPP) computer cards are available from GSSI. Or, when ordering a new computer, request that the manufacturer install a bi-directional parallel port. The extra cost is normally very low.

Start the transfer program on your computer by typing:

SIR2FTR PP:(address of the parallel port)

If you purchased a bi-directional parallel port card from GSSI the above command would be:

SIR2FTR PP:278

where 278 is the address of the parallel port. If your computer has already installed a bi-directional parallel port, you must enter the correct address. To determine the address of your bi-directional parallel port, refer to your computer documentation.

TRANSFER

When the SIR-2 **Transfer** command is activated, a directory of the data files stored on the SIR-2 appears on the screen. Select the files you wish to transfer and then begin the transfer process. Data is transferred at a rate of approximately 30 kilobytes/second.

7.3.1 Alternate Transfer Method: Applying Gains & Filters

During data playback on the SIR-2, additional filters and gains can be applied to the data (for details see Section 5.1) and the processed data can be transferred to a computer. If, during the data playback process, you wish to simultaneously transfer data to a computer, set **XFER** command from the PLAYBACK SETUP OUTPUT MENU to ON. Go to the PLAYBACK DATA MENU block and use the normal procedure to playback files (for details see Section 5.2). As the data is played back, it will be transferred to the computer. The transferred data files will contain any playback processing applied.

7.3.2 Secondary Transfer Method

The SIR-2 also has the capability to transfer data to a computer via the computer's serial port. However, because serial transfer takes twice as long as parallel data transfer and the setup is more complicated, we strongly recommend using the parallel port as the primary method of data transfer. If your office computer does not have a bi-directional parallel port we recommend obtaining one as soon as possible rather than relying on the serial transfer method. Many laptop computers do not have a bi-directional parallel port and cannot have one installed, and in this case it is necessary to use the serial data transfer method.

The procedure for serial data file transfer is as follows:

You will be using the standard MS-DOS v6.2 functions, INTERLNK and INTERSVR, to transfer data from the SIR-2 to your computer. **Should you have any trouble with this procedure, please refer to your MS-DOS manuals included with your system**.

All data files on the SIR-2 are stored in the directory:

D:\SIR_DATA\COMMON

The following procedure should be used to transfer files. This is an abbreviated version and more complete documentation can be found in the MS-DOS manual.

Your computer must be operating under MS-DOS v6.2 or higher. Using the SIR-2 upgrade adapter cable:

1) Turn on your SIR-2 and the computer you will be using for data transfer. Your computer must be operating under MS-DOS v6.2 to perform the transfer. If your computer is not running MS-DOS v6.2, you must load the licensed copy of MS-DOS v6.2 provided with your SIR-2.

1a) Change the config.sys file on your computer to include the line:

device=C:\dos\interlnk.exe

Save the new config.sys file and reboot your computer. You only need to change the config.sys file on your computer once, after that it will remain changed.

2) Connect the SIR-2 upgrade adapter cable to the MULTIFUNCTION port of the SIR-2. Connect the null modem cable, provided with your SIR-2, between the COM1 serial port of your computer and the serial connector of the upgrade adapter cable of the SIR-2 system.

3) Connect a keyboard to the keyboard connector of the SIR-2 upgrade adapter cable.

4) Enter the COLLECT SETUP MENU of the SIR-2.

5) Press the <*ALT*><*S*> keys on the keyboard connected to the SIR-2. The SIR-2 will exit the radar operating system and the prompt

C:>

will appear.

6) Type: INTERSVR on the SIR-2. The interserver menu will now appear.

7) On the computer enter the upper level directory by typing:

CD \

8) Start the interlnk program on your computer by typing:

interlnk

9) On the SIR-2 screen are listed the drives of the computer (client) and the SIR-2 (server). This screen will tell you which drive on the computer (client) equals the D: drive on the SIR-2 (server). Use this computer drive letter in the next few commands. In the instructions below, we assume that the E: drive on the computer equals the D: drive on the SIR-2.

10) On the computer, enter the appropriate drive (in our example the E: drive) by typing:

E:

11) Now change the directory by typing:

cd \sir_data\common

12) To perform the copy type:

Copy *.* "the desired data destination on your computer"

for example:

Copy *.* C:\project1*.*

This will copy all the data from the SIR-2 to your computer and place it in the directory project1 on the C: drive.

13) After the file copy is complete the DOS prompt will show on your computer. Press <*Alt*> <*F4*> on the keyboard attached to your SIR-2 to exit the INTERSVR program.

14) Turn the SIR-2 system OFF and then ON (re-boot). It will now return to the normal radar operating system. You can now delete all transferred files.

Chapter 8: SYSTEM OPERATIONS

8.1 Setting The System Date & Time Clock To Your Local Time

The system maintains the current date and time and this information is entered in the file headers as the data is collected. It is important that the date and time are accurate. Time and Date are accessed from the **System** command in the first column of the COLLECT SETUP MENU block or PLAYBACK SETUP MENU block. For information on the SW CALIBR (Survey Wheel Calibration) refer to Section 4.3.

When **Clock Set** is selected via the *Enter* ↵ key, the current system time and date appear on the screen with an instruction block describing how to change the time and date.

8.2 Procedure To Upgrade The Operating System Software

The following procedure should be used to update or upgrade you SIR-2 operating system when you receive an update or upgrade from GSSI. Your computer must be operating under MS-DOS v6.2, or higher, to perform the upgrade. Using the SIR-2 upgrade adapter cable:

You will be using the standard MS-DOS v6.2 functions, INTERLNK and INTERSVR, to upgrade. **Should you have any trouble with this procedure, please refer to your MS-DOS manuals included with your system**.

1) Turn on your SIR-2 and the computer you will be using for the upgrade. Your computer must be operating under MS-DOS v6.2 to perform the upgrade. If your computer has not been upgraded to MS-DOS v6.2 yet, you can install the licensed copy of MS-DOS v6.2 provided with your SIR-2.

1a) Change the config.sys file on your computer to include the line

device=C:\dos\interlnk.exe

Save the new config.sys file and reboot your computer. Your computer's config.sys file has now been changed to include the interlnk command.

2) Connect the SIR-2 upgrade adapter cable to the MULTIFUNCTION port of the SIR-2. Connect the null modem cable, provided with your SIR-2, between the COM1 serial port of your computer and the serial connector of the upgrade adapter cable of the SIR-2 system.

3) Connect a keyboard to the keyboard connector of the SIR-2 upgrade adapter cable.

4) Enter the COLLECT SETUP MENU of the SIR-2.

5) Press the <*ALT*><*S*> keys on the keyboard connected to the SIR-2. The SIR-2 will exit the operating system and the prompt

C:>

will appear.

6) Type: intersvr on the SIR-2. The interserver menu will now appear.

7) On the computer enter the upper level directory by typing:

   CD \

8) Start the interlnk program on your computer by typing:

   interlnk

9) On the SIR-2 screen are listed the drives of the computer and the SIR-2. This screen will tell you which drive on the SIR-2 equals the C: drive on the computer. Use this SIR-2 drive letter in the next few commands. In the instructions below, we assume that the E: drive on the SIR-2 equals the C: drive on the computer.

   On the computer, make a new directory by typing:

   mkdir (sir2 drive letter):\sir2up

   For our specific example we would type:

   mkdir E:\sir2up

10) Insert your SIR-2 upgrade disk into the floppy drive of your computer and copy the files from the upgrade disk to the SIR-2 by typing:

   Copy (computer floppy drive letter):*.* E:\sir2up*.*

11) After the files have finished copying, the DOS prompt will reappear on the computer.

12) Press <*Alt*> <*F4*> `H$` on the keyboard attached to your SIR-2 to exit the intersvr program.

13) Enter the sir2up directory on the SIR-2 by typing:

   cd \sir2up

14) Finish the upgrade on the SIR-2 by typing:

   upgrd

   A few messages will appear on the SIR-2 screen. You should see the following important ones:

   START OF LOAD

   (loading counter that increases as the program is loaded)

   END OF RUN

15) After the upgrade is complete delete all upgrade files in the SIR-2 by typing:

   Delete \sir2up*.*

16) Turn the SIR-2 system OFF and then ON (re-boot). The upgrade is now complete.

8.3 Hard Disk Maintenance

After approximately every 40 hours of use, two software maintenance functions for the SIR-2 data storage hard disk should be performed to locate lost clusters and disk defragmentation.

1) Connect the SIR-2 upgrade adapter cable to the MULTIFUNCTION port of the SIR-2.

2) Connect a keyboard to the keyboard connector of the SIR-2 upgrade adapter cable.

3) Enter the COLLECT SETUP MENU of the SIR-2.

4) Press the <*ALT*><*S*> `Hs` keys on the keyboard connected to the SIR-2. The SIR-2 will exit the operating system and the prompt

   C:>

   will appear. Change to the D: drive by typing:

   D:

5) To check for lost clusters, type the following command:

   SCANDISK /AUTOFIX /NOSAVE /NOSUMMARY

and answer Y. For details on the SCANDISK command at the DOS prompt type:

SHELP SCANDISK

To exit HELP SCANDISK type:

<*ALT*> <*F*><*X*> `Hfx`

6) Now defragment your hard disk by typing:

   DEFRAG /B

   Select C: drive to optimize.

7) After DEFRAG is complete, turn the system OFF and ON to return to the operating system.

Chapter 9: AUTOMATIC OPERATION

9.1 DATA COLLECTION

The Automatic Operation Mode is initiated by pressing the *Run* key when the SIR-2 is first turned ON and you are given the option at the first menu screen. When this is done, the system will be in Data Collection Set-Up Mode, and you will see a menu on the left side of the screen, and an oscilloscope display of the reflected radar signal on the right. The DATA COLLECTION MENU group will be surrounded by a solid white line, indicating that it is active. The PLAYBACK MENU will be surrounded by a dashed white line, indicating that it is inactive. To activate Playback Mode, toggle the *Collect/Playback* key.

The Automatic Mode of operation was developed to allow simplified operation of the SIR-2 system for the special application of pavement and bridge deck analysis. The menu is less complicated and allows input control over the following parameters; first by highlighting the menu option with the arrow keys, and then using the *Enter* key and the *Arrow* keys to input a value.

In the DATA COLLECTION MENU:

RANGE: 1 to 3 meters in half-meter steps

GAIN: -10 to 10 dB

DIELECTRIC: 0 to 99 - as this value is increased, the time scale on the oscilloscope display also increases, to a maximum of about 70ns.

RESISTIVITY: 0 to 9999. If you do not know this value for the material you are scanning, set to zero.

ENCODER: ON or OFF

Y-AXIS: TIME or DEPTH

In the OUTPUT MENU:

DISK: ON or OFF

DISPLAY: COLOR or GRAY

PRINTER: ON or OFF

FILE NAME: assigned by system when DISK is turned ON, otherwise RAM

Once you have chosen your operating parameters, you can put the system into data acquisition mode by pressing the *Run/Standby* key. If the disk is turned OFF, a courtesy check will appear asking you if you want to start data collection with the disk output OFF, and allows you to reply **Cancel** or **OK**. If you select **OK**, the system will start scanning, and the output will go to RAM. The upper left side of the screen shows the linescan image of the radar profile being collected, the upper right shows an oscilloscope image of the reflected radar signal, and the bottom of the screen shows the current system

parameters. If your data file exceeds the memory limits of RAM (16 MB), the first part of the record will be written over by data currently being recorded. Pressing the *Run/Standby* key at this time will put the system into Standby and a cursor will appear in the radar profile. A scale listing scan numbers will also appear at the bottom of the radar image. You can navigate the cursor around the radar image using the *Arrow* keys, and the window labeled "cursor" will contain position and amplitude information of features you indicate with the cursor. If you get to either end of the image, the screen will display the next or previous 50 scans, depending on which direction you are going. Pressing the *Run/Standby* key again will return the system to Data Acquisition Mode. When in Data Acquisition Mode, pressing the *Run/Standby* key and holding it down for 2 seconds will stop the system scanning and close the file, and the system will return to Setup Mode.

9.2 DATA PLAYBACK

Playback Mode is entered by toggling the *Collect/Playback* key. The PLAYBACK MENU will now be surrounded by a solid white line indicating it is active. In Playback Mode you have the following operational options, which you select and change by navigating through the menu the same way as in Collect Mode:

FILE NAME: allows you to select the file you want to playback for review or printing.

DISPLAY: allows you to select from either color or grayscale.

PRINTER: ON or OFF

PRINT ZOOM: variable from 1 to 5. A value of 1 means that each scan of a data file is printed as one scan on the printer. A value of 2 means that each scan of a file is output as 2 duplicate scans on the printer. A value of 3 means that each scan of a file is output as 3 scans on the printer, etc.

When in Linescan Mode the DPU5400 and the GS-608P print 200 and 203 scans per inch respectively. The SIR-2 video display displays 94 scans per inch. A Horizontal Zoom setting of 2 will give the best match between the video screen and the printout.

Once a file is selected, you can play it back by pressing the *Run/Standby* key. You can stop the system playing back at any point in the file by pressing *Run/Standby* again. This will pause the playback and allow you to move the cursor around to points of interest in the data. You can make position and signal amplitude measurements, which can help you in data interpretation. To resume playback, press the *Run/Standby* key again. When you reach the end of the file, the image will stop scrolling, and the cursor will appear superimposed on the data. To exit Playback Mode, and return to standby, toggle the *Collect/Playback* key.

APPENDIX A: CONTENTS OF THE PARAMETER SETUP FILES

A.1 Brief Description Of Pre-Loaded Setups

2500HS	This setup is for the 2500 MHz Horn antenna at high data acquisition speed. Maximum data acquisition speed 80kph (50mph) with a sample interval of 0.4m. Range 10ns.
2500HHR	2500 MHz Horn antenna for high horizontal resolution pavement evaluation. Maximum data acquisition speed 11kph (7mph) with a horizontal sample interval of every 1 cm. Range 10ns.
1000HS	1000 MHz Horn Antenna at high data acquisition speed. Maximum data acquisition speed 80kph (50mph) with a sample interval of 0.4m. Range 20 ns.
1000HHR	1000 MHz Horn Antenna for high horizontal resolution road evaluation. Maximum data acquisition speed 11kph (7mph) with a horizontal sample interval of every 1 cm. Range 20ns.
1000TAD	1000 MHz standard antenna for concrete and roadway evaluation. Depth of viewing window is approximately 1m. Range 15ns.
1000TAS	1000 MHz standard antenna concrete and roadway evaluation. Depth of viewing window is approximately 50cm. Range 8ns.
900TAVD	900 MHz antenna shallow archeological and airport runway investigations. Depth of viewing window is approximately 2m. Range 30ns.
900TAD	900 MHz antenna concrete, roadway and runway evaluations. Depth of viewing window is approximately 1m. Range 15ns.
900TAS	900 MHz antenna concrete and roadway evaluations. Depth of viewing window is approximately 50cm. Range 8ns.
500D	500 MHz antenna “deep” viewing depth. Range 100ns.
500S	500 MHz antenna “shallow” viewing depth. Range 60ns.
500DPH	500 MHz dual power antenna on high transmit power setting. Range 100ns.
500DPL	500 MHz dual power antenna on low transmit power setting. Range 100ns.
400D	400 MHz antenna, “deep” viewing depth. Range 100ns. Appropriate for utilities, archaeology surveys, etc.

400S	400 MHz antenna, “shallow” viewing depth. Range set at 60ns. High resolution for utility detection.
300D	300 MHz antenna, “deep” viewing depth. Range 300 ns.
300S	300 MHz antenna, “shallow” viewing depth. Range 150 ns.
200D	200 MHz antenna, “deep” viewing depth. Range 300ns.
200S	200 MHz antenna, “shallow” viewing depth. Range 150 ns.
120D	120 MHz standard antenna, “deep” viewing depth. Range 400 ns.
120S	120 MHz standard antenna “shallow” viewing depth. Range 200 ns.
100D	100 MHz antenna normal transmitter power, “deep” viewing. Range 500 ns.
100S	100 MHz antenna normal transmitter power “shallow” viewing. Range 250 ns.
100HP	100 MHz antenna with high power transmitter. Range 500 ns.
100VHP	100 MHz antenna with very high power transmitter. Range 500 ns.
80MHz	80 MHz folded bow-tie antenna. Range 1000 ns.
LF120CM	Low Frequency antenna 1.2m length. Range 250 ns.
LF240CM	Low Frequency antenna length 2.4m. Range 500 ns.
LF360CM	Low Frequency antenna length 3.6m. Range 750 ns.
LF480CM	Low Frequency antenna set to a length of 4.8m. Range 1000 ns.
LF600CM	Low Frequency antenna set to a length of 6.0m. Range 1000 ns.
BH120	Borehole antenna frequency 120 MHz. Range 500 ns.
BH300	Borehole antenna frequency 300 MHz. Range 300 ns.

A.2 Common setup parameters independent of antenna used

The following parameters are common to all **pre-loaded setup** files.

Output Disk: *OFF*
Output Print: *OFF*
Output Display: *LINESCAN*
Display Color Table: *2*
Display Color Transform: *1*
Dielectric Constant: 0
Units: Meters
Screen: Full
2D Grid: OFF
Playback: Clear Processing

A.3 Setup parameters dependent on antenna to be used

2500HS

This setup is for the 2500 MHz Horn antenna operated at high data acquisition speed. Maximum data acquisition speed 80kph (50mph) with a sample interval of 0.4m. Depth of viewing window is approximately 60cm (assuming a dielectric constant of 5).

Data Collection Mode: *Survey Wheel*
Range: 10ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 300 MHz
Vertical Low Pass Filter: 5000 MHz
Scans per second: 64
Horizontal Smoothing: 0 scans
Survey Interval: 0.4m
Distance Mark: 50m
Transmit Rate: 64 KHz

2500HHR

This setup is for the 2500 MHz Horn antenna, for high horizontal resolution road evaluation. Maximum data acquisition speed 11kph (7mph) with a horizontal sample interval of every 1 cm. Depth of viewing window is approximately 60cm (assuming a dielectric constant of 5).

Data Collection Mode: *Survey Wheel*
Range: 10ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 300 MHz
Vertical Low Pass Filter: 5000 MHz
Scans per second: 64
Horizontal Smoothing: 0 scans
Survey Interval: 5cm
Distance Mark: 5m
Transmit Rate: 64 KHz

1000HS

This setup is for the 1000 MHz Horn antenna at high data acquisition speed. Maximum data acquisition speed 80kph (50mph). Depth of viewing window is approximately 1m (assuming a dielectric constant of 5).

Data Collection Mode: *Survey Wheel*
Range: 20ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 200 MHz
Vertical Low Pass Filter: 2000 MHz
Scans per second: 64
Horizontal Smoothing: 0 scans
Survey Interval: 0.4m
Distance Mark: 50m
Transmit Rate: 64 KHz

1000 HHR

This setup configures the 1000 MHz Horn antenna for high horizontal resolution road evaluation. Horizontal sample interval every 1cm. Maximum data acquisition speed 11kph (7mph). Depth of viewing window is approximately 1m (assuming a dielectric constant of 5).

Data Collection Mode: Survey Wheel
Range: 20ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 200 MHz
Vertical Low Pass Filter: 2000 MHz
Scans per second: 64
Horizontal Smoothing: 0 scans
Survey Interval: 5cm
Distance Mark: 5m
Transmit Rate: 64 KHz

1000TAD - CONCRETE AND ROADWAY EVALUATION

1000 MHz standard antenna. Depth of viewing window is approximately 1m assuming a dielectric constant of 5. With an antenna traverse speed of approximately 32cm per second, the horizontal sampling is 1 scan per cm.

Data Collection Mode: *Continuous*
Range: 15ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 250 MHz
Vertical Low Pass Filter: 2000 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

1000TAS - CONCRETE AND ROADWAY EVALUATION

1000 MHz standard antenna. Depth of viewing window is approximately 50cm assuming a dielectric constant of 5. With an antenna traverse speed of approximately 32cm per second, the horizontal sampling is 1 scan per cm.

Data Collection Mode: *Continuous*
Range: 8ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 250 MHz
Vertical Low Pass Filter: 2000 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

900TAVD - SHALLOW ARCHEOLOGICAL AND AIRPORT RUNWAY INVESTIGATIONS

900 MHz antenna. Depth of viewing window is approximately 2m assuming a dielectric constant of 5. With an antenna traverse speed of approximately 50cm per second, the horizontal sample interval is approximately 2cm.

Data Collection Mode: *Continuous*
Range: 30ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 100 MHz
Vertical Low Pass Filter: 1800 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

900TAD - CONCRETE, ROADWAY AND RUNWAY EVALUATIONS

900 MHz antenna. Depth of viewing window is approximately 1m assuming a dielectric constant of 5. With an antenna traverse speed of approximately 32cm per second, the horizontal sampling is 1 scan per cm.

Data Collection Mode: *Continuous*
Range: 15ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 100 MHz
Vertical Low Pass Filter: 1800 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

900TAS

900 MHz antenna. Depth of viewing window is approximately 50cm assuming a dielectric constant of 5. With an antenna traverse speed of approximately 32cm per second, the horizontal sampling is 1 scan per cm.

Data Collection Mode: *Continuous*
Range: 8ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 4
Vertical High Pass Filter: 100 MHz
Vertical Low Pass Filter: 1800 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

500D

500 MHz antenna. Depth of viewing window is approximately 5m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 100ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 1000 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

500S

500 MHz antenna. Depth of viewing window is approximately 3m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 60ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 1000 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

500DPH

500 MHz dual-power antenna on high transmit power setting. Depth of viewing window is approximately 5m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 100ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 1000 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 32 KHz

500DPL

500 MHz dual power antenna on low transmit power setting. Depth of viewing window is approximately 5m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 100ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 1000 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 32 KHz

400D

400 MHz antenna. Depth of viewing window is approximately 5m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 100ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 800MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

400S

400 MHz antenna. Depth of viewing window is approximately 3m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 60ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 800 MHz
Scans per second: 32
Horizontal Smoothing: 4 scans
Transmit Rate: 64 KHz

300D

300 MHz antenna. Depth of viewing window is approximately 15m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 300ns
Samples per Scan: 1024
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 1000 MHz
Scans per second: 32
Horizontal Smoothing: 5 scans
Transmit Rate: 64 KHz

300S

300 MHz antenna. Depth of viewing window is approximately 7m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 150ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 1000 MHz
Scans per second: 32
Horizontal Smoothing: 5 scans
Transmit Rate: 64 KHz

200D

200 MHz antenna. Depth of viewing window is approximately 15m assuming a dielectric constant of 9.

Data Collection Mode: Continuous
Range: 300ns
Samples per Scan: 1024
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 400 MHz
Scans per second: 32
Horizontal Smoothing: 5 scans
Transmit Rate: 64 KHz

200S

200 MHz antenna. Depth of viewing window is approximately 7m assuming a dielectric constant of 9.

Data Collection Mode: Continuous
Range: 150ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 400 MHz
Scans per second: 32
Horizontal Smoothing: 5 scans
Transmit Rate: 64 KHz

120D

120 MHz standard antenna. Depth of viewing window is approximately 20m assuming a dielectric constant of 9. Note: The 120 MHz antenna is unshielded.

Data Collection Mode: Continuous
Range: 400ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 240 MHz
Scans per second: 32
Horizontal Smoothing: 5 scans
Transmit Rate: 64 KHz

120S

120 MHz standard antenna. Depth of viewing window is approximately 10m assuming a dielectric constant of 9. Note: The 120 MHz antenna is unshielded.

Data Collection Mode: Continuous
Range: 200ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 240 MHz
Scans per second: 32
Horizontal Smoothing: 5 scans
Transmit Rate: 64 KHz

100D

100 MHz antenna normal transmitter power. Depth of viewing window is approximately 25m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 500ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 25 MHz
Vertical Low Pass Filter: 200 MHz
Scans per second: 16
Horizontal Smoothing: 5 scans
Transmit Rate: 64 KHz

100S

100 MHz antenna normal transmitter power. Depth of viewing window is approximately 12m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 250ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 25 MHz
Vertical Low Pass Filter: 200 MHz
Scans per second: 16
Horizontal Smoothing: 5 scans
Transmit Rate: 64 KHz

100HP

100 MHz antenna with high power transmitter and fiber optic. Depth of viewing window is approximately 25m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 500ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 25 MHz
Vertical Low Pass Filter: 200 MHz
Scans per second: 16
Horizontal Smoothing: 5 scans
Transmit Rate: 32 KHz

100VHP

100 MHz antenna with very high power transmitter and fiber optic. Depth of viewing window is approximately 25m assuming a dielectric constant of 9.

Data Collection Mode: *Continuous*
Range: 500ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 25 MHz
Vertical Low Pass Filter: 200 MHz
Scans per second: 16
Horizontal Smoothing: 5 scans
Transmit Rate: 16 KHz

80MHz

80 MHz folded bow-tie antenna. Note: The 80 MHz antenna is unshielded.

Data Collection Mode: *Continuous*
Range: 500ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 25 MHz
Vertical Low Pass Filter: 200 MHz
Scans per second: 32
Stacking: 32 scans
Transmit Rate: 32 KHz

LF120CM

Low Frequency antenna 1.2m length. Note: The MLF antennas are unshielded.

Data Collection Mode: *Point*
Range: 250ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 160 MHz
Scans per second: 32
Stacking: 32 scans
Transmit Rate: 32 KHz

LF240CM

Low Frequency antenna length 2.4m

Data Collection Mode: *Point*
Range: 500ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 15 MHz
Vertical Low Pass Filter: 90 MHz
Scans per second: 32
Stacking: 32 scans
Transmit Rate: 32 KHz

LF360CM

Low Frequency antenna length 3.6m

Data Collection Mode: *Point*
Range: 750ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 10
Vertical Low Pass Filter: 60
Scans per second: 32
Stacking: 32 scans
Transmit Rate: 32 KHz

LF480CM

Low Frequency antenna set to a length of 4.8m

Data Collection Mode: *Point*
Range: 1000ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 5
Vertical High Pass Filter: 6
Vertical Low Pass Filter: 40
Scans per second: 32
Stacking: 32 scans
Transmit Rate: 32KHz

LF600CM

Low Frequency antenna set to a length of 6.0m

Data Collection Mode: *Point*
Range: 1000ns
Samples per Scan: 512
Resolution: 8 bits
Number of gain points: 5
Vertical High Pass Filter: 1
Vertical Low Pass Filter: 50
Scans per second: 32
Stacking: 32 scans
Transmit Rate: 32 KHz

BH120

Borehole antenna frequency 120 MHz. Note: The borehole antennas are unshielded.

Data Collection Mode: *Point*
Range: 500ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 30 MHz
Vertical Low Pass Filter: 240 MHz
Scans per second: 32
Stacking: 32 scans

BH300

Borehole antenna frequency 300 MHz.

Data Collection Mode: *Point*
Range: 300ns
Samples per Scan: 512
Resolution: 16 bits
Number of gain points: 5
Vertical High Pass Filter: 38 MHz
Vertical Low Pass Filter: 600 MHz
Scans per second: 32
Stacking: 32 scans

Appendix B: SELECTING THE PROPER ANTENNA

GSSI offers many antennas of different frequencies and functions that can be operated with the SIR-2. There will one or two GSSI antennas best suited for your application. It is important that you select the correct antenna for your application in order to obtain the best possible results.

Your depth of interest for a particular application will determine the correct antenna to use. The deeper the depth of interest, the lower the frequency of antenna you should use. The higher the antenna frequency, the greater the resolution or ability to see smaller targets.

For best results, you should select the highest frequency antenna that will cover your depth of interest (Table B1). For example, if you were looking for pipes down to 2.5 meters depth, both the 300MHz and 500MHz antennas are capable of penetrating to that depth. In most cases, you should select the 500MHz antenna because it provides better resolution. If you do not have that frequency antenna available, you can try the next lower frequency antenna (in this example the 300MHz), but you should realize that it will have decreased ability to see small targets.

Depth Range of Interest	Best antenna to use	Second Choice
0-0.5m(0-1.5ft)	2500MHz horn	900MHz
0-1m (0-3ft)	900MHz	500MHz
0-2.5m (0-8ft)	500MHz	300MHz
0-9m (0-30ft)	300MHz	100MHz
0-20m (0-60ft)	MLF	100MHz
0- >20m (0- >60ft)	MLF	100MHz

Best GSSI antennas to use for a given depth range of investigation

TABLE B1

APPENDIX C: SIR SYSTEM-2 SPECIFICATIONS

Hardware

RADAR PROCESSOR: Motorola DSP-56002
CPU: 80486DX
RAM MEMORY:
IDE INTERNAL HARD DRIVE
DISPLAY: 21cm color active matrix LCD VGA for real-time display, 640 x 480 pixels.
INPUTS/OUTPUTS

- 1 Antenna Input(including survey wheel)
- 1 12VDC Power Input
- 1 Upgrade cable (includes Keyboard (PC/AT-compatible) and RS-232 connectors
- 1 Fiber Optic Transmit Trigger
- 1 Parallel Connector
- 1 Audible Warning Beeper (speaker)
- 3 LED Indicators, 2 Power, 1 hard drive

PRINTER: Optional thermal plotter for real-time hard copy of wiggle-trace or grayscale linescan data.

Software

DATA COLLECTION: Continuous profile, survey wheel-controlled or stacking (point collection) modes. DISPLAY MODE: User-selected; color/grayscale linescan, wiggle trace or oscilloscope data formats. Menus and system parameters.

RANGE GAIN: Automatic or user-selected; range gain function **prior** to digitization for maximum system dynamic range.

DATA TRANSFER: Through parallel port. Serial transfer to laptop computers.

Electrical

TRANSDUCER: operates with any GSSI model transducer.

RANGE: 6-3000 nanoseconds full scale, user selectable, fixed ranges of 8,15, 25, 35, 50, 70, 100, 150, 200, 250, 300, 400, 500, 750, 1000.

PULSE REPETITION RATE: Automatically selected, 8 to 64 KHz.

SAMPLING: Automatically or manually selected, 128, 256, 512, 1024, or 2048 samples/scan.

QUANTIZATION: 8 or 16-bit

INPUT POWER: 12VDC from vehicle or belt mounted, rechargeable battery pack with operating range of 10-12.5 volts, 100 watts.

Mechanical

29cm x 27cm x 14cm (11.4in x 10.6in x 5.5in)

6.3kg(13.8lbs)

Environmental

OPERATING TEMPERATURE: 0^{o} C to 40^{o} C (32 F to 104 F) external.

RELATIVE HUMIDITY: 0-100%

STORAGE TEMPERATURE: -25^{o} C to 50^{o} C (-20^{o} F to 122^{o} F)

WATER: Splashproof - not intended to be immersed!

DUST: All sensitive components are housed in dust-resistant enclosures.

APPENDIX D: LIST OF NOTES AND CAUTIONS

D.1 LIST OF NOTES

HOW TO USE THIS MANUAL

PAGE 1

NOTE:

This manual assumes that you will have a SIR-2 available and in operation when reading this manual.

Help can be obtained on any command by pressing the *Help* (?) key. General system help is obtained by pressing the HELP (?) key and then the ENTER (↵) key.

CHAPTER 1: INTRODUCTION

PAGE 5

NOTE:

The SIR-2 is designed to operate from 0°C (32°F) to 40°C (104°F). The SIR-2 control unit can operate in dusty, humid or foggy environments, but it should not be deliberately subjected to direct rain.

Turning the system so that the screen does not directly face the sun and using the sun shade will make the data easier to view in bright sunlight.

CHAPTER 2: BASICS OF SYSTEM OPERATION

PAGE 7

NOTE:

If you are going to playback data, it is preferable not to connect the antenna to the SIR-2 before powering ON the system.

PAGE 8

NOTE:

If the green light is dark and the system will not power ON, you have inadequate input power. Check your power source and connections between your power cables.

PAGE 9

NOTE:

General system help can be obtained by pressing the HELP (?) key and then the ENTER (↵) key**.**

If at any time you are unsure of the current system parameter's settings press the *Collect/Playback* (%) key until the system parameters screen appears.

PAGE 11

NOTE:

When the SIR-2 is first turned ON it is in Setup Mode.

To put the system in the DATA MENU block, press the *Run/Standby* (▪) key.

When in a DATA MENU block, to return the system to Setup Mode select **Go To Setup Mode** from the first menu column**.**

PAGE 12

NOTE:

Throughout the remainder of the manual when the expression "select a command" is used, it means move the highlight bar to illuminate that command and then press the *Enter* (↵) key. This will select (i.e., activate) that command.

CHAPTER 3: SYSTEM SETUP FOR DATA COLLECTION

PAGE 18

NOTE:

The survey wheel must be calibrated at your survey site before use.

PAGE 23

NOTE:

When manually adjusting the gain curve, if the gains are set correctly, the largest signals (reflections) in the oscilloscope display should be 50% to 75% the width of the display and the data screen should show mostly (60% to 80%) red, orange and yellow reflections. The colors described above are based on Color Table 2. If you use a different Color Table the correct gain colors will be different.

We recommend using 5 gain points.

PAGE 24

NOTE:

If you select a parameters setup file for your antenna, the filters will automatically be set and you should not be concerned with changing them unless you change antennas.

CHAPTER 4: Data Collection

PAGE 33

NOTE:

ALL users should read section 4.2.

PAGE 36

NOTE:

If the system sounds a continuous BEEPing sound while collecting data with a survey wheel, it means you are pulling the wheel too fast. Either slow down your rate of acquisition or decrease the Scans/Unit value in the survey wheel setup.

Page 37

NOTE:

The antenna marker switch can not be used to close the data file at the end of a line in Point Mode. You must use the *Run/Standby* key to close the file in this mode. This is done by holding the *Run/Standby* key depressed for 2 seconds at the last station on the line.

CHAPTER 6: OPERATION WITH THE GSSI DPU-5400 AND GS-608P THERMAL PLOTTERS

PAGE 47

NOTE:

Because of the required high data acquisition speeds of the SIR-2, only the GSSI DPU-5400 and GS-608P printers can be used with the SIR-2. Other printers are not supported.

PAGE 47

NOTE:

The printer should not be connected during power-up of the SIR-2. If the SIR-2 seems to hang up during power-up, disconnect the printer (or parallel data transfer) cable.

Chapter 7: File Operations - Compress, Delete & Transfer

PAGE 49

NOTE:

If you wish to compress, delete or transfer all the disk files, or a majority of the files, you should first activate the **Select All** command at the bottom of the second column of the File commands.

D.2 LIST OF CAUTIONS

CHAPTER 1: INTRODUCTION

PAGE 4

CAUTION:

If you power the system from an automobile battery, you must keep the car running while operating the system.

If during system operation the input power becomes low, the green light above the power button will begin flashing. You should shut down the system as soon as possible and replace or recharge your power source.

CHAPTER 2: BASICS OF SYSTEM OPERATION

PAGE 7

CAUTION:

If you connect a printer to the SIR-2, the printer must be powered ON before the SIR-2.

PAGE 8

CAUTION:

If the battery voltage is low, the green light above the power button will flash. If the green light is flashing you should correct the low voltage problem before starting the system.

PAGE 12

CAUTION:

Data stored to RAM is lost when the system is powered OFF or when the next data file is collected. To permanently store your data you must store you data to **Disk** (i.e., set the **Disk** parameter to ON).

CHAPTER 3: SYSTEM SETUP FOR DATA COLLECTION

PAGE 17

CAUTION:

When the Setup Mode is set to **Auto**, the Gain, Position, Filters and Scan parameters will be hidden.

PAGE 28

CAUTION:

The Scans/Second parameter must be set to 32 or less when printing data during acquisition.

The Horizontal Zoom must be set to 1 when printing data during acquisition.

CHAPTER 5: DATA PLAYBACK AND REVIEW

PAGE 40

CAUTION:

Gains applied to the data during playback are not stored in the data file. They are only applied to the displayed data. When gains are applied to the data during playback and data transfer is ON, or **Disk=ON**, the data stored on the receiving computer or the internal hard disk will have this additional gain applied. The internal hard disk file will have a letter appended to the original file name.

PAGE 45

CAUTION:

The measurement of two-way travel time or depth assume that the surface reflection is at the top of the data screen. If it is not then the measurements will be incorrect.

Chapter 7: File Operations - Compress, Delete & Transfer

PAGE 50

WARNING

The SIR-2 parallel data transfer cable should only be connected to a bi-directional parallel port of your computer. The parallel ports of most computers are output only. If you connect the parallel data transfer cable to an output only parallel port on your computer damage will occur to the computer parallel port. If you are uncertain that your computer has a bi-directional parallel port, do not connect the cable and try it, refer to your computer manual or call your computer sales representative. GSSI is not responsible for any damage that occurs to computer parallel ports.

Simple to install, bi-directional parallel port computer cards are available from GSSI. Or, when ordering a new computer request that the manufacturer install a bi-directional parallel port, the extra cost is normally very low.

Information on SIR-2 printer paper usage rates and hard disk storage:

The SIR-2 printer paper rolls are 100m long. The SIR-2 prints real-time (maximum horizontal density) at 80 scans/cm. Assuming 32 scans/sec, you can print 6 km of data at an acquisition rate of 1m/sec., for a total print time of 17 hours.

HARD DISK DATA STORAGE

Depending when your SIR-2 was manufactured, it has one of the following hard drives:

ST9235AG	HARD DISK DRIVE	210MB 2-1/2”
ST9550AG	HARD DISK DRIVE	455MB 2-1/2”
ST9655AG	HARD DISK DRIVE	524MB 2-1/2”

You can call GSSI (1-800-524-3011) to learn which hard drive was installed in your instrument. Please have the serial no. ready when you call.

Index

Date	Rev	Revision	DRN	CKD	APPD
6/94	-	Released	PH	KAV	SRH
6/96	A	Revised per ECO #1346	PH	KAV	SRH

GSSI USER MANUAL COMMENT SHEET

Please note below any suggestions for improvement or any errors found in this manual. Return this form to:

Paul Hague
Geophysical Survey Systems, Inc.
13 Klein Drive
North Salem, NH 03073-0097

MANUAL TITLE: _____

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THANK YOU FOR YOUR HELP